MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for February, 1904, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph, and mail, 167; West Indian Service, cable and mail, 4; River and Flood Service, regular 43, special river and rainfall, 190, special rainfall only, 56; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 3025; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. R. C. Lydecker, Territorial Meteorologist, Honolulu, Hawaii; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander H. M. Hodges, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. José Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or $10^h\ 30^m$ west of Greenwich. The Costa Rican standard meridian is that of San José, $5^h\ 36^m$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

Exceptionally severe weather prevailed along the transatlantic steamer routes of the North Atlantic Ocean during the first and second decades of the month, and in a number of instances gales were experienced as far south as the Azores. From the 23d to the 28th generally high barometric pressure over the British Isles and low pressure over Spain and Portugal was attended by abnormally low temperature over western Europe.

Over the western Atlantic the month opened with a storm of marked intensity moving eastward over New England and the Canadian Maritime Provinces. The 3d, 7–8th, 15–16th, 22d–25th, and the 29th were stormy days on the middle Atlantic and New England coasts, the severest gales of the month in that region occurring on the 15th and 16th. No severe storms were reported on the Gulf of Mexico or its coasts. The principal Lake storms of the month occurred on the 2d and 6–7th, with a maximum reported wind velocity of 64 miles an hour at Buffalo, N. Y., on the 7th. Storms of less-marked severity crossed the Lake region on the 14th, 21st–22d, 23d, 24th, and 29th. On the north Pacific coast the month was usually stormy, and on a number of dates the gales that attended the passage of storms across the northern coast line extended southward over California. As a rule, the storms that appeared on the north Pacific coast crossed the United States, those that followed a northern track being attended by gales on the Great Lakes and the Atlantic seaboard. The storms from the North Pacific that followed a southeast track dissipated or diminished greatly in intensity upon reaching the southwestern and Gulf districts. Ample warning was given to all American ports of the important windstorms of the month.

From the northeastern slope of the Rocky Mountains eastward to the Atlantic coast and southeastward over the east Gulf and South Atlantic States the month was colder than the average February, and from the Missouri Valley over the Lake region, Ohio Valley, and Middle Atlantic and New England States exceptionally low temperatures prevailed. In the Southwestern States and from the Rocky Mountains to the Pacific coast the temperature averaged above the normal. The month opened with a cold wave of marked intensity over the Atlantic seaboard, and on the morning of the 2d the lowest temperatures of the present winter were registered in the Middle Atlantic States. During the night of the 5th a cold wave swept southward over the Plateau and Rocky Mountain districts, and extended thence eastward to the Atlantic coast by the 8th. The third well-marked cold wave of the month advanced from the British Northwest Territories over the West and Northwest during the night of the 13th, covered the central valleys during the 14th, and reached the Middle Atlantic and New England States during the night of the 15th, where the temperature continued very low until the 17th. The decided falls in temperature were forecast and made the subject of special warnings.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	*31, a. m.	52	105	2, a. m.	33	79	2,100	2.0	1,050	43.8
II	*31, p. m.	28	98	2, a. m.	33	79	1,225	1.5	817	34.0
III	1, p. m.	50	107	3, a. m.	36	87	1,500	1.5	1,000	41.7
IV	2, p. m.	50	110	4, p. m.	35	79	2,100	2.0	1,050	43.8
V	9, a. m.	52	104	13, p. m.	46	60	2,375	4.5	528	22.0
VI	12, p. m.	55	114	18, p. m.	44	74	2,550	6.0	425	17.7
VII	16, p. m.	41	124	21, a. m.	41	70	3,150	4.5	700	29.2
VIII	21, a. m.	33	97	24, a. m.	27	83	1,525	3.0	508	21.2
IX	23, p. m.	50	107	27, p. m.	46	60	2,575	4.0	644	26.8
X	27, p. m.	53	108	29, p. m.	48	68	1,950	2.0	975	40.6
XI	29, a. m.	41	100	†2, a. m.	40	73	1,575	2.0	788	32.8
Sums							22,625	33.0	8,485	353.6
Mean of 11 paths							2,057		771	32.1
Mean of 33 days										32.1
Low areas.										
I	*31, a. m.	51	114	3, a. m.	45	67	2,400	3.0	800	33.3
II	4, a. m.	48	125	8, a. m.	46	60	3,650	4.0	912	38.0
III	7, a. m.	43	113	10, p. m.	25	82	2,625	3.5	750	31.2
IV	11, p. m.	47	125	14, p. m.	29	95	2,150	3.0	716	29.8
V	12, p. m.	53	103	16, a. m.	47	60	2,650	3.5	757	31.5
VI	15, p. m.	47	125	19, p. m.	26	82	3,225	4.0	806	33.6
VII	19, p. m.	51	104	22, p. m.	48	69	2,300	3.0	767	32.0
VIII	20, p. m.	29	94	22, p. m.	27	80	950	2.0	475	19.8
IX	22, a. m.	42	107	25, a. m.	46	60	2,375	3.0	792	33.0
X	22, a. m.	53	125	24, p. m.	30	95	2,150	2.5	860	35.8
XI	23, p. m.	47	122	26, p. m.	33	92	1,925	3.0	642	26.8
XII	26, a. m.	52	120	28, p. m.	48	69	2,300	2.5	920	38.3
XIII	27, p. m.	38	105	†1, a. m.	46	78	1,600	2.5	640	26.7
Sums							30,300	39.5	9,837	409.8
Mean of 13 paths							2,331		757	31.5
Mean of 39.5 days										31.5

*January. †March.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*C. C. Cooper.*

Ice gorges and resultant floods in localities in the Middle Atlantic States and floods in California are discussed under the head Rivers and Floods.

BOSTON FORECAST DISTRICT.

The weather was notable for severe and persistent storms, during which violent gales prevailed along the coast, the wind in some instances reaching hurricane force. The severest storms were those of the 1st and 15th. During the latter storm the Boston fishing schooner *Irene and May* ran ashore near the entrance to Provincetown Harbor. The life-savers went to the assistance of the fishermen, and all were saved. The vessel was not greatly damaged. Along the northern shore of Massachusetts Bay this was considered one of the worst storms of the season. The month, so far as temperatures are concerned, is unprecedented in the records of the New England weather service. The mean for the entire district was 16.6°, and the next lowest was 18.0° in 1901. Shipping was greatly inconvenienced and delayed by the unusually low temperatures and stormy weather, although few casualties resulted. Seventeen storm warnings were issued during February and were generally fully justified.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

The month was abnormally dry. Notwithstanding favorable conditions for precipitation on several dates, only one general rainstorm occurred during the month. Decided falls in temperature occurred in parts of the district on the 3d, 8th, 10th, 14th, 15th, 18th, 19th, 27th, and 29th, for all of which forecasts or warnings were issued. Storm warnings were issued for all high winds that occurred during the month. No severe storms occurred.—*I. M. Cline, District Forecaster.*

CHICAGO FORECAST DISTRICT.

The month was marked by temperature far below the normal throughout the entire district, except in the extreme western portion. The cold was persistent, although not, as a rule, very severe. There were during the month two or three temporary breaks in these conditions. The month opened cold over the the eastern half of the forecast district, and a moderate cold wave appeared in the British Northwest on the same day, which was followed by another on the 6th and 7th, which lasted for several days. After a temporary moderation, another cold wave appeared in the Northwest on the 13th, and overspread the entire district on the 14th and 15th, causing the lowest temperatures of the winter at many stations. A cold wave appeared again in the extreme northwest on the 20th, and within forty-eight hours it passed eastward across the district. There was still another, which developed on the 24th, with practically the same movement as its predecessor. Warnings were sent out in advance of the movement of these cold waves, and no considerable fall in temperature occurred without the proper notification.

As the temperature continued very low in the extreme northwest during practically the entire month, the storms approaching from the North Pacific were diverted southward over the middle Rocky Mountain region. These disturbances were of frequent occurrence, and, while no individual storms caused general heavy snows, the aggregate snowfall for the month for the northern portion of the forecast district was considerable.

The transportation companies which usually maintain winter navigation endeavored to continue service, but were handicapped considerably by the large amount of ice in the lake. The car ferries and steamboats were stalled in the ice for several days at a time, and very few trips were made by boats navigating along the west shore, although the car ferries which went across from Michigan to Wisconsin met with better success.

Later developments show that Lake Michigan was not frozen over, as was supposed, for a time during January, but it is true that the ice was thicker and there was less open water than have prevailed for twenty or thirty years.

Several storms crossed Lake Michigan during the month and advices of their coming were sent to vessel masters. The managers were also fully advised as to the probable direction of the wind from day to day, as the condition of the ice in the lake depends largely upon the direction of the wind.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

Notwithstanding the number of low areas that crossed the Continental Divide in Wyoming and Colorado, the month was unusually mild, and for the greater part of the district exceedingly dry. Cold waves, warnings of which were timely, were notably few, moderate, and of short duration. For Colorado the month was the mildest February in sixteen years. Windstorms from westerly quadrants were frequent on the eastern slope, the gale of the 1st being very severe along the foothills of Colorado and Wyoming.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

The month was essentially different from the preceding months of this winter. The latter were abnormally dry, and the pressure distribution of the type common to drought periods over the extreme southwestern portion of the country. During February a marked difference in pressure distribution will be found to exist. The rainfall, which had been so deficient throughout southern California as to seriously injure pasturage and cause a considerable loss of stock, fell during the month of February opportunely and in such quantities as to insure the crops. Had the dry spell continued longer, serious loss would have resulted in southern California. The month was unusually free from frost. This is not always the case with rainy seasons, although the general law holds that such

seasons have less frost than others. Storm warnings were displayed frequently. Beginning February 24 special attention was given to the river conditions in northern California. Warnings were sent in ample time to river towns on the American, Yuba, and Feather rivers, also on the upper Sacramento. Warnings of high water for the reclaimed lands between the Sacramento and San Joaquin rivers were issued with the evening forecasts and distributed by the Associated Press. The work was of direct and positive value in saving lives and property. Much stock was removed from the lowlands in time.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND FORECAST DISTRICT.

The month of February was unusually stormy in this district. Four vessels were wrecked, as follows: Three-masted schooner *Emma Utter*, loaded with 360,000 feet of lumber, abandoned off Grays Harbor, February 11, came ashore in Barclay Sound, Vancouver Island, February 16; vessel and cargo total loss; crew saved. Schooner *Gem* sailed from San Francisco February 3, reported wrecked on Nehalem Beach, Oreg., February 16; vessel and cargo total loss; crew saved. Steam schooner *Fulton*, 300 tons, with 500,000 feet of lumber, ran out of fuel oil during storm of February 12 and was beached near Port Oxford, Oreg.; 1 man was drowned; the underwriters have strong hopes of saving this vessel. The three-masted schooner *Frank W. Howe*, loaded with railroad ties, was wrecked during a storm of February 22, a few miles north of the North Head, Wash., Weather Bureau station; 2 of the crew were lost; vessel and cargo a total loss. Warnings were issued in every instance well in advance of all severe storms, and the casualties that occurred were to vessels at sea beyond the reach of warnings. The work of the Weather Bureau vessel-reporting station at North Head, Wash., during the month has been very creditable. The first intimation of the disabled condition of the schooner *Frank W. Howe* was received from that station. The observer notified the life-saving crews in the neighborhood, and they were on the ground almost by the time the vessel reached the shore, and no time was lost in rescuing the crew. This station was also the means of saving the steam schooner *Grace Dollar* which became disabled during a severe storm and was drifting helplessly about. As soon as the observer sighted her he notified the tugs at Astoria, Oreg., one of which found and towed her to a safe anchorage after a very perilous trip over the bar at the mouth of the Columbia River. The disabled condition of the *Grace Dollar* was previously reported by the British Bark *Thistle*, but at this time the helpless vessel was too far out at sea for the tugs to locate her, and it is believed that it was the definite information received from the North Head Weather Bureau station which made the rescue of the vessels possible.

No cold waves occurred, nor were any cold-wave warnings issued.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The ice situation can be summarized as follows:

At the end of January, 1904, the Missouri River was frozen to near the Iowa-Missouri line, with 24 inches of ice at Williston, 29½ inches at Bismarck, 19 inches at Sioux City, and 13 inches at Omaha. One month later the only change noticeable was an increase, ranging from 3 to 6 inches, in the thickness of the ice. The Mississippi River on January 31 was frozen as far south as the mouth of the Illinois River, the thickness of the ice ranging from 26 inches at St. Paul to 16 inches at Hannibal. By the end of February there had been an increase of 11 inches at St. Paul and 1 inch at Hannibal. The river at Hannibal was open from the 7th to 17th, inclusive, and again on the 29th. At St. Louis heavy ice was persistent until February 25, when navigation was resumed. At Memphis the heaviest ice in many years was observed February 3 and 4, suspending navigation and endangering boats along the river. The river was clear from the 5th until the end of the month, except from the 21st to 24th, inclusive. The Ohio River was free from gorges, but ice in greater or less quantities was constantly running until the 25th. There were some attempts at navigation, but nothing was done in a general way until February 24 and 25. The Kentucky River opened on February 24.

The great gorges in the Susquehanna River continued throughout the month. The conditions gradually became more threatening and serious, and at the end of the month the situation was the most dangerous of the entire winter. The persistent cold weather had solidified the gorges, and the only hope of averting greater danger and destruction than that which had already befallen the valley lay in the possibility that slowly moderating weather would permit the ice to go out gradually, reducing the loss to a minimum. The following report on the conditions during the month was prepared by Mr. E. R. Demain, official in charge, United States Weather Bureau office, Harrisburg, Pa.:

At the close of January the river was icebound at Huntingdon, Lockhaven, and Wilkesbarre, with the great gorges of ice in the main river near Bainbridge and in the North branch from Kipps Run to Berwick still intact.

On February 5 the weather map indicated rain and decidedly warmer weather for the Susquehanna Valley, and the following bulletin was, therefore, given the widest possible publication and distribution:

"River conditions are again becoming threatening. A storm, now approaching from the west, will cause a decided rise in the temperature and probably rain over the Susquehanna Valley to-night and on Sunday. Should the rainfall be heavy, which is likely, the ice in the river will probably break up and go out on a flood that may cause great damage to property and possibly endanger human life. Persons living on lowlands near the river, or those having live stock on river bottoms, are particularly cautioned to keep a close watch, as a sudden gorging of ice might cause their lands to become submerged. No one can positively predict what the outcome will be, but the public is warned that the possibilities of a damaging flood are considered great, and all should be prepared as far as possible to meet any danger that may arise."

On February 6 the following bulletin was published on the weather map:

"The conditions continue favorable for an early break-up of the ice and a flood in the river, probably within forty-eight hours. Indications are for rain over the Susquehanna Valley to-night, the rain continuing Sunday."

The first reported break in the ice occurred at Lockhaven on the night of February 7, the ice gorging near Jersey Shore. The break in the Juniata occurred at Huntingdon on February 7, the river reaching a maximum stage of 9.0 feet during the night. At Wilkesbarre the ice began to break up at 5:15 a. m., February 8, and moved past the city until February 10, when it once more became stationary, owing to the formation of a gorge at Nanticoke, about 9 miles below. The water backed up till it reached a stage of 25.7 feet at 4 p. m. on February 9. Ice from Williamsport and points below on the West branch began to pass Selinsgrove on the night of February 8, and early on the following night the breaking of the gorge at Jersey Shore caused another heavy flow to begin. All this ice passed Harrisburg and lodged on the gorges below. On the afternoon of February 9 a section of the great gorge in the North branch moved, beginning a short distance above Berwick and stopping at Mifflinville. The ice in its progress moved the bridges at Berwick and Mifflinville from their piers. At 8 a. m., February 10, the river at Bloomsburg registered 29.5 feet, and at Catawissa 28.5 feet. Some previous high-water stages at Catawissa were as follows: March 18, 1865, 28.9 feet; March 3, 1902, 27.3 feet; and January 25, 1904, 29.3 feet, the latter stage the highest known.

A cold wave on the night of February 8 caused the West branch and the Juniata to begin to fall early on February 9, and on the morning of February 10 reports showed that the waters of all the streams of the system were receding. On account of the gorges, the waters fell very slowly from the great pools, and no material relief was afforded the flooded territory for several days, the severe weather intensifying the suffering of the people whose homes had been flooded. Low-lying farm lands, as well as the lower portions of towns and cities suffered severely, and the following statement relative to a single farm, taken from the Catawissa News Item of February 18, fairly represents the conditions obtaining on many farms along the river bottom.

"His farm buildings have been badly wrecked by the ice which covers the farm, and the house shows the effect of the flood. Several hundred bushels of potatoes in the cellar are a total loss, and the corn in the crib is frozen solid. The farmer has moved everything movable, and will not return to the farm until the floods are over. If the ice goes off with high water, every building on the place will go with it."

The Juniata at Huntingdon and the West branch at Lockhaven again

froze over on the night of February 12, and the river at Harrisburg closed at the pumping station of the city waterworks at 12:15 a. m., February 14, with 13.5 feet of water on the gage, the highest point at which the river here was ever known to become icebound. The gorge was caused by floating ice lodging on the gorges below Harrisburg, the ice backing up gradually, and covering the surface of the river to a depth of several feet. This gorge extended to Duncannon, about 18 miles above Harrisburg, by the night of February 16.

No material changes occurred in the general conditions during the remainder of the month. One cold period closely followed another, and the gorged ice became more and more solidified. The month closed with the people of the towns and lowlands along the river waiting for the general break-up, and hoping for such weather conditions as would remove the threatened danger with the least possible loss of property.

No danger line stages occurred, except those caused by the gorges in the North branch.

There were no changes of consequence in any of the New York or New England rivers, except an increase in the thickness of the ice. There were no ordinary, free-running floods during the month, except in northern California, where the continued heavy rains caused marked and rapid rises in all of the rivers. Warnings were issued from San Francisco on February 16, 22, 23, 24, and 27. At Red Bluff a stage of 28.2 feet was recorded on February 16, the highest stage on record with the exception of that of 29.5 feet on February 4, 1881. At Marysville, on the Yuba River, a stage of 20 feet was reached at 3 a. m., February 25. This was 1 foot above the danger line, as well as the highest recorded stage. The highest stage reached at Sacramento was 27.9 feet on February 26. This was 2.9 feet above the danger line for the reclaimed lands south of the city, some of which were overflowed. It is difficult to estimate the total damage due to the floods. Many thousands of acres were overflowed, but it is doubtful if much damage was done to the crops, and there is an offset in the increased fertility due to alluvial deposits. The warnings issued were very accurate, and they afforded occasion for the expression of many words of commendation from the press and others interested, particularly along the upper Sacramento River.

The highest and lowest water, mean stage, and monthly range at 202 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, District Forecaster.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Divison.

The following summaries relating to the general weather and crop conditions during February are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—First two decades cool, wet, and unfavorable for plowing, except in northern counties, where rainfall was light; last decade dry, warm, and favorable, and farm work pushed; considerable land prepared for cotton and corn; a little corn planted; oats and wheat did well; acreage in oats about average; large acreage in Irish potatoes. Gardening well advanced; some early vegetables up. Peaches and plums blooming freely in southern and middle counties at close of month; strawberries promising.—*F. P. Chaffee.*

Arizona.—Though there was some cold weather early in February, the greater part of the month was warm. Drought conditions continued to prevail, and there was but little snow on the mountains at the end of the month. Crops did well where sufficient water was obtainable, but generally the month was unfavorable to agricultural interests. Droughty conditions greatly diminished the acreage of grain. Stock interests suffered and greater suffering was feared.—*M. E. Blystone.*

Arkansas.—There was an excess in temperature during the month, the last week being unusually warm. The precipitation was below normal, but was sufficient to put the ground in fine tilth. More than the usual amount of plowing was done, and considerable progress was made in sowing small grains. Stock wintered nicely and was generally thrifty. Fruit sustained no material injury from severe weather.—*Edward B. Richards.*

California.—The remarkably heavy rainfall in the central and northern sections was in a measure beneficial to all crops, but materially changed estimates of the yield of grain in portions of the San Joaquin and Sacramento valleys; many thousand acres of wheat and barley were flooded by high waters, and it is doubtful if any crops will be raised there. Elsewhere, and especially in the southern districts, the rain was of immense benefit and crop prospects are very fair.—*Alexander G. McAdie.*

Colorado.—The month was very favorable for stock, and losses were small, although in localities in the north-central and south-central counties and along the Divide the ranges were poor and stock-water scarce. Good pasturage was general throughout the eastern counties. There was little frost in the soil of the eastern slope, and some plowing and seeding were done, but dryness and high winds were unfavorable. The snowfall, while greater than during January, was much less than normal, and will not materially increase the supply of water for irrigation.—*F. H. Brandenburg.*

Florida.—The month was favorable for farm work, which was well advanced. Land was prepared for cotton and corn; some early planted corn in southern counties was above the ground. The bulk of the cane crop was planted and about the last of the orange crop shipped. Vegetable shipments were light. Citrus trees showed a heavy bloom and groves generally were in a splendid condition. Pineapples made a fair growth and the prospect for peaches was good. An increased acreage of cotton was indicated.—*A. J. Mitchell.*

Georgia.—The temperature was practically normal; a prominent feature was the absence of cold waves, but there were several periods of low temperatures. The precipitation was below the normal except over a limited area in the southwest. Farm work was retarded by the prevailing weather. The outlook for wheat was favorable, but fall oats were inferior. The prospects for fruit were bright.—*J. B. Marbury.*

Idaho.—The month was unusually mild, permitting grass to make a good start and causing fruit and shade trees to bud in sheltered valleys. Precipitation was heavy, the average exceeding all previous records for February. Snow accumulated rapidly in the mountains, giving promise of an abundance of water for placer mining and irrigation. Winter wheat was reported in good condition. Stock wintered well.—*Edward L. Wells.*

Illinois.—The temperature was below normal. Low maxima rather than low minima were the characteristics. Precipitation was deficient and fell mostly in the form of snow or sleet. The ground was well covered until the latter part of month, when a general thaw ensued. The condition of wheat was unpromising. Some fields were reported badly damaged and others winter-killed. Much damp, soft corn remained in hand, and the scarcity of good seed corn is a matter of concern. Meadows and pastures were well preserved in northern and central districts. Peach buds were seriously damaged.—*Wm. G. Burns.*

Indiana.—Severe cold weather caused much apprehension as to the safety of wheat in the northern and greater portion of the central sections, but the high temperature and rain on the 28–29th cleared the fields of snow and ice, and examinations made after March 1 indicated better prospects for a crop than had been expected. In the southern section and a few southeast counties of the central section wheat was thin on the ground, short, and brown, and the prospects were poor.—*W. T. Blythe.*

Iowa.—There has been but one colder February in the past fifteen years, viz, in 1899. The precipitation was generally light, and there were no severe storms to interrupt travel or hinder the usual farm operations. Conditions were favorable for the care of stock, and for preparatory work for spring seeding. The limited area of fall wheat and rye was exposed to low temperature without snow covering and probably suffered some damage.—*John R. Sage.*

Kansas.—The dry moderate weather was quite favorable for outdoor work, and much plowing was done in the southern counties and some in the central. Wheat continued in fair condition in the southern and central counties, but was somewhat damaged in the northern by the cold dry weather. Oat sowing progressed in some of the southern counties. Cattle did well.—*T. B. Jennings.*

Kentucky.—Freezing weather during most of the month, with very little snow, and winter grasses suffered further damage. The prospect for wheat was apparently very poor. Some correspondents stated that the root was good, but the general opinion was that wheat was seriously damaged. As no warm weather occurred of sufficient duration to start the buds, fruit trees were believed to be in good condition. Tobacco beds were burned when weather permitted and a few beds were seeded. Stock wintered well, considering the cold weather.—*H. B. Hersey.*

Louisiana.—Favorable weather for outdoor work prevailed during the greater part of the month. Preparations for cotton planting were pushed vigorously in most sections, and, as a rule, were well advanced. The bulk of the land to be planted in corn was broken and some corn planted in the southern parishes. Stubble and fall plant cane did well; seed cane was in good condition and spring planting well advanced. Rice seeding had commenced. Spring oats were doing well. Truck gardens and berries were growing nicely—*I. M. Cline.*

Maryland and Delaware.—The month was very cold and precipitation

was deficient, though frequent and well distributed. Outside of the mountain districts wheat and grasses had scant protection from snow and were further damaged, grasses apparently suffering much less than wheat, which was in the worst condition for years at the close of February. Peaches were probably considerably injured in northern districts. Stock were reduced in flesh and dairy products curtailed as a result of the severe weather.—*Oliver L. Fassig.*

Michigan.—Winter wheat and rye were covered with snow and ice all of the month. The thaw of February 5 to 7 melted some of the snow and was immediately followed by a severe cold wave, which formed a sheet of ice over much of the southern and central counties of the State. The continued low temperatures and this ice covering prevented winter growth, and many correspondents expressed the fear that the ice was smothering the plants and damaging them to some extent.—*C. F. Schneider.*

Minnesota.—The month was very cold; minimum temperatures were below zero somewhere in the State daily until the 27th, and maximum temperatures below 32° until the 25th, except on a few days in southern portions. The 27th, 28th, and 29th were much the warmest days of the month. Moderate snows fell during the month, and snow covered the whole State to depths ranging from about 3 inches in the southwest to considerably greater amounts in the timber regions of the northeast. No farming operations were possible except the care of the farm stock.—*T. S. Outram.*

Mississippi.—Owing to the very light rainfall and generally mild temperature the month was unusually favorable for farm work. The soil was in splendid condition and plowing for corn and cotton was in full progress, being well advanced west and south. Oat sowing was nearly completed. Garden truck was up and doing well south and being planted north. At the close of the month fruit trees were in full bloom.—*W. S. Belden.*

Missouri.—In most sections the month was remarkably dry. In portions of the northeast section wheat was fairly well protected by snow and sleet, but elsewhere the ground was bare the greater part of the month, and in many counties the crop was considerably damaged. Except in the extreme southern counties, however, there was but little alternate thawing and freezing, and while the tops of the plants were killed to a considerable extent, the roots were not thought to be seriously injured.—*A. E. Hackett.*

Montana.—Except west of the main range and in the southwestern counties the month averaged considerably colder than usual, especially in the northeastern and north-central districts, due to continuously cold weather rather than to unusually low minimum temperatures. Precipitation was very generally above normal and snowfall was generally heavy in the mountains, but there was a slight deficiency in the northeastern counties and over a small area immediately to the east of the main divide.—*E. S. Nichols.*

Nebraska.—The exceedingly dry weather of February was unfavorable for fall sown grain, but in the absence of severe storms, cold weather, and high winds, the damage to the crops probably was not large. However, the soil is very dry because of three consecutive dry months. The wheat plant seems to have lived well, and with sufficient moisture in the spring will probably largely recover.—*G. A. Loveland.*

Nevada.—The month was very much milder than the average February. Heavy and continuous warm rains in the northern and western sections during the latter part of the month broke all previous records of rainfall for duration and amount. Heavy falls of snow in the mountains from the 4th to 7th made prospects exceedingly bright for a good water supply next summer. Range stock were in much better condition than usual at the close of winter.—*J. H. Smith.*

New England.—February was the coldest month of its name in the history of the New England climate and crop service, the next lowest mean temperature being 18° in 1901. The minimum temperature at Van Buren, Me., —43°, is the lowest of record excepting —44° at West Milan, N. H., in 1889. The precipitation was generally deficient excepting in southeast Massachusetts, where it was somewhat in excess; there was a marked deficiency in northern Vermont and New Hampshire, where a water famine existed. The depth of snowfall was unusually large in all sections.—*J. W. Smith.*

New Jersey.—The mean temperature for the month was within 1° of the coldest February, 1895. Freezing weather almost continuous; ground frozen to the depth of 30 inches in many places; winter grain and grass seriously injured on low fields; soil water-tight; ground bare of snow after the 20th. Apple buds dormant; peach buds badly affected; some pear trees cracked by severe cold. Preparation of hotbeds greatly retarded owing to frozen condition of soil.—*Edward W. McGann.*

New Mexico.—The drought continued, there having been scarcely any precipitation on the plains since last September, and comparatively little in the mountains. Streams were very low and many good wells dry. Owing to the mild winter, stock continued in good condition, but moisture was needed to start spring growth. Conditions were becoming alarming.—*R. M. Hardinge.*

New York.—The month was abnormally cold with no continuous thaw, and was very windy. Thawing conditions early in month (principally on the 7th) greatly reduced the depth of snow, leaving many fields covered with ice, which was unfavorable for grain and grass. Severe weather worked greatly to the disadvantage of dairying interests, and it was feared that fruit was damaged, although opinions on this point varied decidedly. The severest winter in sixteen years or longer.—*R. G. Allen.*

North Carolina.—February was continuously cold and without any extended warm periods to stimulate growth. Much winter wheat was cut to the ground, though probably the roots are not killed; much of the crops was hardly up. There was very little improvement in wheat, oats, or rye until toward the close of the month when more abundant precipitation and rising temperatures caused the commencement of growth. Very little plowing was done, and no truck crops were planted. Lettuce under cover and strawberries are in good condition.—*C. F. von Herrmann.*

North Dakota.—The month was the severest for the past thirteen years. Heavy snow so covered the open ranges that stock running at large could get but little to eat, while in sections where hay is put up and stock fed during severe weather the feeding was continued so long that but little hay was left.—*B. H. Bronson.*

Ohio.—There was a marked deficiency in temperature. The highest temperature occurred generally on the 7th or 29th, and the lowest on the 4th, 16th, and 20th. Precipitation was well distributed throughout the month. There was a slight excess in the northern half of the State and a moderate deficiency in the southern. Wheat was injured by the cold weather. There were many reports that the wheat fields presented a brown appearance, and some that the plants were dead.—*J. Warren Smith.*

Oklahoma and Indian Territories.—The month was warm and dry. Crops in ground did well, the subsoil moisture having been plentiful. Wheat made slight growth, but was in fair condition generally; the plant was small, well rooted, and greening up. At the close of the month the ground was in good condition, preparations for planting corn and cotton were in progress, oat seeding was well advanced, early potatoes and garden vegetables were being planted, and fruit trees were budding. Stock did well, notwithstanding scarcity of feed.—*C. M. Strong.*

Oregon.—February was an unusually wet and stormy month, but no damaging cold weather occurred. No progress worth mentioning was made in plowing or seeding and the farmers were generally behind with their spring work. Fall wheat was healthy, none had been winter killed, nor had it made much advancement in growth; it promised, however, to make a good start with the advent of settled weather and sunshine.—*Edward A. Beals.*

Pennsylvania.—With the exception of 1895 and 1901, this was the coldest February in seventeen years. The average precipitation was only about two-thirds the normal. The weather, as a whole, was unfavorable for winter grain and grasses. The ground was frozen to an unusual depth; many fields were unprotected at times by snow, and high winds, rains, and low temperature materially injured the tops of grain. No accurate estimate of the damage done to fruit was possible at the close of the month.—*T. F. Townsend.*

Porto Rico.—Sugar making continued throughout the month and the grade of juice improved somewhat, but was generally below the normal for the season at many haciendas, on account of continued wet weather. Young canes and ratoons generally in good condition. Much cane planted during the month. Tobacco cutting continued during the month; yield generally good. Coffee began to blossom early in the month and continued; first blossoming was rather light. Small crops and fruits were generally plentiful. Oranges began to get scarce toward the close of the month. Some beans were harvested. Pasturage poor in the southern districts and cattle suffered.—*E. C. Thompson.*

South Carolina.—Plowing made good progress over the eastern part of the State, but was hindered by wet and cold weather in the western division. Tobacco beds were seeded, and spring oats sown. Some gardening was accomplished. Wheat and oats made slight growth. Fruit trees began blooming in the extreme southern sections; peach buds were slightly damaged by sleet and ice on the 11th.—*J. W. Bauer.*

South Dakota.—The month was unusually cold, with normal and fairly well distributed snowfall. Winter rye and the limited amount of winter wheat sown were favorably protected by snow, except in the extreme southeast, where some injury probably resulted. The continuous cold, especially in the north portion, was unfavorable to live stock on the open ranges, though no material losses were reported. Accumulated snow necessitated steadier feeding than usual in the eastern portion.—*S. W. Glenn.*

Tennessee.—Continued cold and dry weather; no snow protection; unfavorable for the growth of winter grains, in which little or no improvement was noted. Wheat early drilled or planted deep and fertilized withstood the adverse conditions fairly well, but much of the late planting was so poor that it was plowed up for other crops. Fall sown oats and clover mostly winter killed. Seeding oats and plowing in progress during the last week.—*H. C. Bate.*

Texas.—The greater portion of the State received moderate to good rainfall on the 5th, 18th, 19th, and 20th. Moderately cool waves overspread the State on the 10-11th and 19-20th, giving freezing temperatures to near the coast region. Wheat, barley, rye, and fall sown oats made a marked improvement, and these crops were in fair to average condition, except in the extreme west portion, where they were severely damaged by the drought. The sowing of spring oats progressed rapidly. Spring work was never further advanced for time of year. Plowing was generally completed and the ground in first-class condition. During the

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Summary of temperature and precipitation by sections, February, 1904.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	49.0	+ 1.8	Dothan, Flomaton	83	27	Anniston, Riverton	18	1, 4	3.80	−1.48	Eufaula	9.15	Decatur	1.25
			Prattville	83	27									
Arizona	51.6	+ 3.6	Parker	96	24	Flagstaff	− 5	6	0.38	−0.49	Natural Bridge	1.34	4 stations	0.00
Arkansas	44.8	+ 2.9	New Louisville	86	26	Forrest City	10	11	2.47	−1.38	Dallas	5.01	Pond	0.18
California	54.5	+ 0.3	Imperial	93	24	Bodie	−13	18	7.91	+4.25	Bowmans Dam	45.61	3 stations	0.00
			Volcano Springs	93	23, 24									
Colorado	33.4	+ 7.8	Blaine	90	28	Lay	−32	10	0.55	−0.40	Ruby	5.73	6 stations	0.00
Florida	60.8	+ 1.4	Inverness	89	19	Middleburg	23	2	3.03	−0.45	Fort Meade	6.91	Flamingo	T.
			Orlando	89	29									
Georgia	47.3	0.0	Waverly	84	7	Diamond	5	2	4.04	−1.14	Americus	9.60	Greenbush	1.64
Idaho	30.2	.....	Garnet	73	26	Paris	−31	10	3.10	.....	Soldier	8.33	Oakley	0.95
Illinois	23.2	− 3.7	Cairo	74	28	Knoxville	−19	1	1.60	−0.77	Halfway	3.94	Carrollton	0.24
Indiana	24.5	− 4.1	Worthington	80	28	Northfield	−18	4	2.57	−0.48	Angola	4.77	Farmersburg	0.90
Iowa	14.8	− 4.8	Keosauqua	70	6	Fayette	−26	1	0.41	−0.63	Ridgeway	1.99	Osceola, Thurman	T.
Kansas	32.6	+ 2.6	Medicine Lodge	91	23	Wallace	− 7	10	0.11	−1.03	Atchison	1.55	6 stations	0.00
Kentucky	35.2	0.0	Beattyville	75	7	Loretto	− 2	11	2.32	−1.65	Owenton	4.02	Burnside	1.09
			Cadiz	75	28									
			Franklin	75	29									
Louisiana	57.1	+ 4.7	Franklin	89	18	Cheneyville	20	1	2.27	−2.76	Amite	5.70	Lawrence	0.53
			Robeline	89	26									
Maryland and Delaware	26.9	− 4.9	Oakland, Md	70	7	Oakland, Md	−15	20	1.79	−1.92	Bachmans Valley, Md	3.42	Chewsville, Md	0.34
Michigan	9.0	−10.7	Berrien Springs	50	7	Omer	−40	17	2.03	+0.02	Manistee	4.70	Baldwin	0.35
			Mt. Clemens, South Haven.	50	7									
Minnesota	2.3	− 8.3	Beardsley	43	27	Pokegama Falls	−55	16	0.62	+0.10	Crookston, St. Charles	1.80	St. Cloud	0.18
Mississippi	51.7	+ 3.4	Okolona	89	27	Austin	20	13	2.60	−2.65	Magee	5.60	Pontotoc	1.19
						Water Valley	20	16						
Missouri	30.0	− 0.2	Dean	82	28	Sublett	−18	1	0.91	−1.34	Jackson	3.80	Grant City	T.
Montana	17.2	− 4.4	Fort Harrison	57	27	Billings	−42	16	1.37	+0.62	Columbia Falls	4.62	Augusta	0.15
Nebraska	24.7	+ 1.7	Halsey	78	5	Agate	−23	10	0.13	−0.53	O'Neill	0.70	3 stations	0.00
Nevada	35.9	+ 4.2	Martin's Ranch	73	15	Potts	−15	9	2.48	+1.33	Lewer's Ranch	18.14	Sodaville	0.21
			McAfee's Ranch	73	22									
			Sodaville	73	26									
New England*	16.6	− 6.5	Mount Tom, Mass	59	7	Van Buren, Me	−43	6	2.39	−1.05	New Bedford, Mass	4.65	Chelsea, Vt	0.51
New Jersey	24.8	− 5.8	Lakewood, Barnegat	65	7	Layton	−16	10	2.45	−1.66	New Brunswick	3.09	Layton	1.36
New Mexico	42.2	+ 6.6	Carlsbad	100	24	Winsors	0	11	0.16	−0.50	Taos	0.90	3 stations	0.00
New York	15.5	− 7.4	Addison, Fayettville, Waverly.	58	7	North Hammond	−26	2	2.46	−0.31	Adams Center	6.80	Plattsburg	0.50
North Carolina	38.1	− 4.6	Rockingham	82	7	Linville	− 1	2	3.72	−0.64	Edenton	5.91	Marshall	1.72
North Dakota	−2.2	− 8.8	Hannaford	52	27	McKinney	−42	10	0.54	+0.21	Palermo	2.00	Melville	T.
Ohio	22.9	− 4.5	New Richmond	75	7	Bladensburg	− 18	20	2.69	−0.11	Montpelier	4.39	Philo	0.75
Oklahoma and Indian Territories.	44.3	+ 5.6	Eldorado, Okla	98	25	Kenton, Woodward, Okla.	3	10	0.23	−1.07	Goodwater, Ind. T.	4.69	10 stations	0.00
Oregon	37.2	+ 0.2	Gardiner	63	4, 22	Pine	− 5	2	10.31	+4.87	Buckhorn Farm	30.83	Beulah	0.90
			Jacksonville	63	26									
Pennsylvania	21.8	− 5.8	Hawthorn	68	7	Smethport	−27	2	2.41	−1.09	Hawthorn	4.80	Scranton	0.92
Porto Rico	73.5	.....	Cayey	92	7	Adjuntas	48	11	4.23	.....	Cidra	12.70	Coamo	0.06
			Bayamon	92	21	Barros	48	25						
						Coamo	48	25						
South Carolina	45.2	− 2.3	Florence	86	7	Clemson College	15	2	3.59	−0.91	Walterboro	5.35	Allendale	1.95
South Dakota	9.7	− 5.0	Pine Ridge	69	5	Kidder	−39	7	0.60	+0.04	Silver City	2.95	Cavite	0.05
Tennessee	41.2	+ 1.3	Harriman	79	9	Silver Lake	2	2	2.27	−2.41	Knoxville	4.42	Covington	0.85
Texas	55.4	+ 5.4	Camp Eagle Pass	100	23, 24	Tulia	6	11	1.56	−0.08	Brenham	5.52	Tulia	0.00
Utah	34.2	+ 5.4	Rockville	89	25	Henefer	−26	10	1.53	+0.30	Park City	5.00	3 stations	T.
Virginia	31.8	− 4.4	Cape Henry	77	7	McDowell	− 8	2	2.38	−1.20	Hampton	4.93	Woodstock	0.75
Washington	34.3	− 0.8	Zindel	64	4	Republic	−15	9	5.35	+2.07	Clear Water	18.79	Ritzville	0.74
West Virginia	29.3	− 3.5	Doane	80	29	Pickens	−13	17	2.37	−1.18	Pickens	4.55	Romney	0.52
Wisconsin	7.3	− 8.8	Darlington	56	6	Osceola	−47	1	1.17	−0.02	Oconto	3.15	Dodgeville	0.35
Wyoming	26.0	+ 6.3	Marquette	73	4	Border	−33	10	1.51	−0.13	South Pass City	7.50	2 stations	T.

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

last week corn planting was begun in all sections. Gardens were made and Irish potatoes were being planted. The fruit crop suffered no damage and peach trees were in bloom. Strawberries were doing well and promised a large yield. Stock generally passed through the winter in fair condition.—*L. H. Murdoch.*

Utah.—Abnormally warm weather prevailed during the latter part of the month. Precipitation was decidedly above the normal over the northern portion, and the prospective water supply in this region was very good. Over the remainder of the section precipitation was slightly deficient, and, owing to the droughty conditions that prevailed all winter, the supply of irrigation water will probably fall far short of the demand. Wheat was generally reported to be in good condition. Stock had wintered well and were thriving.—*R. J. Hyatt.*

Virginia.—The condition of winter wheat and oats, rye, clover, and fall grasses remained practically unchanged throughout the month. Ample snow protection was had in nearly all localities, but previous severe weather had caused so much damage that crops were not specially benefited thereby. Extensive winter killing of late seeded fall grain occurred. Spring plowing was much behindhand and but little preparation for tobacco seed beds had been made. Orchards were in good condition.—*Edward A. Evans.*

Washington.—Although the month was somewhat colder than normal there were no severe freezes. The temperature was very uniform, and not unfavorable to the growth of winter grain, nor to fruit trees. There was heavy rain west of the Cascade Mountains, and heavy snowfall east. Most of the snow remained on the ground, forming a desirable covering for the winter wheat. The winter had been favorable for winter wheat, and, as far as could be judged, it was in good condition; the abundant moisture from melting snow should cause it to grow rapidly when spring arrives, and should also be very favorable to spring-sown crops.—*G. N. Salisbury.*

West Virginia.—The weather during February continued cold and dry, and the soil was frozen to a considerable depth. Wheat, rye, oats, and grass were generally in very poor condition, having had scarcely any protection from snow, and the prospects were that some fields would be plowed up. No plowing or other farm work was done. Stock were generally in good condition, but feed was becoming scarce in some counties.—*E. C. Vose.*

Wisconsin.—The month was the coldest February in the central and southern portions of the State since 1885, and probably the coldest February on record in the northwestern counties. Although extremely low temperatures were recorded throughout the State, it is generally believed that no damage to crops resulted, as winter grains and grasses were protected by an ample covering of snow. Stock were reported as wintering in good condition.—*W. M. Wilson.*

Wyoming.—The temperature throughout the State for the month was in excess of the normal and there were no severe storms. As a result stock continued in excellent condition and very little feeding had to be done. The mild weather started the grass in some sections, so that a green tinge was given to the low places. A good supply of snow accumulated in the mountains of the western and northern portions of the State, but a marked deficiency existed at the close of the month over the southeastern portion.—*W. S. Palmer.*

SPECIAL ARTICLES.

DISPOSITION OF RAINFALL IN THE BASIN OF THE CHAGRES.

By Gen. H. L. ABBOT, U. S. A., retired, dated Cambridge, Mass., March 4, 1904.

The question of what becomes of the precipitation falling from the clouds upon a given catchment basin—what part escapes through the channels of the streams, what part is evaporated, what is absorbed by plant life, and finally what part sinks into the earth as ground water—has received much attention from hydraulic engineers by reason of its important bearings upon the water supply of cities, the irrigation of arid regions, and the development of water power. To be of utility, such studies must be based upon long-continued measurements of the rainfall at localities suitable to afford a true estimate of the average precipitation upon the region in question during each of the different seasons of the year, together with accurate gagings of the outflowing streams during the same periods. For a complete solution, further observations to determine the evaporation from land and water surfaces and the absorption of moisture by plants are desirable to furnish a check upon the values found for the other and more important elements, but the extreme difficulty of such studies has usually proved a bar to undertaking them. It must not be forgotten, however, that a portion of the water apparently lost by infiltration into the earth may ultimately find its way into the streams as ground water, and as such may be detected, at least approximately, by a careful investigation of the ratio between downfall and drainage in different seasons of the year. Even in this simplified form the labor and expense involved in the needful measurements have restricted their application to a few localities, and those generally situated in populous and temperate districts.

In connection with their other technical investigations the engineers of the New Panama Canal Company found it obligatory to study some of these questions with considerable attention, and this paper is written in the hope that the resulting facts and figures may prove useful in throwing light upon the more general problem of the ultimate disposition of rainfall.

The Isthmus of Panama is a locality specially favorable to studies of this character. Ice and snow, which have usually complicated such investigations, are here unknown. The region is practically in its natural condition, densely covered with the luxuriant growth of the Tropics. The temperature of the air, which largely influences evaporation, hardly varies from month to month and from year to year, thus in a great measure eliminating one important element of relative uncertainty. Finally, the rainfall is excessive, and is sharply divided between a dry season of three months and a rainy season of seven months, with two intermediate months of less marked character. This fact, as will appear later, has greatly favored the analysis. It seems not improbable that results obtained under so favorable conditions may not only be applicable to similar regions in the Tropics but may also throw light upon certain elements common to more northern latitudes.

The district covered by these measurements is the basin of the Chagres above Bohio, at which locality will be placed the lower reservoir dam creating a large lake to be traversed by shipping as part of the canal route. Under present conditions all outflow from above passes Bohio. The catchment basin is naturally divided into three subbasins, the lower extending to Gamboa, where the Chagres first joins the canal route; the middle extends thence to Alhajuela, where a second dam should be placed; the upper includes the valley above this point. The surveys of the Panama Railroad, supplemented by those of the two Panama Canal companies, have well defined the watershed of the two lower subbasins, as well as the western and much of the southern boundaries of the upper subbasin; but a gap exists on the northern and eastern boundary of the latter where the line of demarcation is somewhat uncertain for a distance of about 35 miles. One point nearly in the middle of the unknown portion was determined by a reconnaissance made by a party of the Isthmian Canal Commission coming from the San Blas district to the head of the eastern branch of the upper Chagres, and this point together with the well known general character of the district, low ridges separated by narrow gorges, have enabled the ill-defined part of the boundary to be laid down on the map with fair precision. All the rest of the entire watershed of the basin being accurately determined, no error can exist in the estimated area large enough to sensibly affect any practical conclusions to be based on the study. The following table exhibits, in statute miles, the dimensions of the basin, which is a hilly rather than a mountainous district, and much of it is covered with a dense tropical growth. The highest summits rarely if ever rise more than about 1500 feet above sea level:

Subbasin.	Basin above Bohio.				Length of bed.	Number of affluents.
	Area.	Per cent.	Length.	Width.		
Upper	320	46	18	18	31	?
Middle	130	18	7	18	11	15
Lower	250	36	11	23	20	17
Total	700	100	.....	.....	70	.....

Before stating the general conclusions resulting from the study it will be well to consider in some detail the several important elements upon which they are based.

RAINFALL IN THE BASIN ABOVE BOHIO.

So many data have been collected respecting rainfall upon the Isthmus of Panama that the monthly and yearly precipitation is well understood. The records kept by the Panama Railroad Company at Colon are nearly continuous since 1862, and those kept on the Pacific coast and at various intermediate points by the two Panama Canal companies are nearly continuous since 1881. The figures were published in the MONTHLY WEATHER REVIEW for May, 1899, and March, 1903. Those specially valuable in the present study date from 1895, when the daily measurements of discharge were extended to include Alhajuela, near the site of the projected upper dam. Unfortunately, they were discontinued at this post in 1897 and 1898, but were resumed in 1899 and are still in progress. All rain gages are read and recorded daily. The respective heights above the ground in their vicinity are the following: At Colon, 30 feet; at Alhajuela, 8 feet; at Gamboa, 36 feet; at Bohio, 6 feet; and at La Boca, 2.5 feet.

What is needful in the present study is a knowledge of the average monthly rainfall in each of the three subbasins, from which that in the entire basin may be deduced. Bohio and Gamboa are near each other and at the extremities of the lower subbasin; Gamboa and Alhajuela are also near each other and at the extremities of the middle subbasin; finally, from the fact that the Pequeni, the largest and most important

branch of the upper Chagres, heads near Porto Bello only about five miles from the Atlantic coast, where the conditions as to rainfall are similar to those at Colon, it may be assumed that a mean between the recorded rainfall at Alhajuela and at Colon will fairly represent the precipitation in the upper subbasin. Introducing the areas of the subbasins, and reducing, the following expressions result for the rainfall, in millimeters, in the entire basin and for that above Gamboa as well; in them B, G, A, and C denote rainfall, in millimeters, at Bohio, Gamboa, Alhajuela, and Colon, respectively:

(1) Rainfall above Bohio $= 0.323\ (0.6\ B + 0.9\ G + A + 0.7\ C)$.

(2) Rainfall above Gamboa $= 0.5\ (0.3\ G + A + 0.7\ C)$.

The following table presents the rainfall, in millimeters, computed as above indicated for the several basins under consideration during the entire period of these studies. As rain records at Alhajuela were lacking in 1898 and in the first six months of 1899, the figures for those months have been found by assuming that the rainfall in the upper subbasin is represented by that noted at Colon. Similar check comparisons for subsequent months have shown that no important errors are thus introduced. Bold-face figures for May, 1902, indicate interpolations, all records being lacking for this month.

TABLE 1.—*Average rainfall, in millimeters, in the basin of the Chagres.*

Month.	Basin above Bohio.							Basin above Gamboa.						
	1898.	1899.	1900.	1901.	1902.	1903.	Means.	1898.	1899.	1900.	1901.	1902.	1903.	Means.
January..	140	156	89	19	464	16	147	99	152	81	15	232	14	99
February.	11	96	24	15	12	5	27	6	104	4	9	10	5	23
March....	27	56	12	37	52	17	34	20	33	11	38	42	15	27
April.....	108	27	74	43	163	32	75	78	24	71	48	148	22	65
May.....	238	267	234	320	**266**	271	266	230	285	264	298	**270**	273	270
June.....	283	236	383	270	183	263	270	267	193	377	280	291	273	265
July.....	579	403	432	279	268	400	394	512	431	451	225	336	450	401
August....	532	305	311	428	241	350	361	395	303	320	391	204	376	332
September	198	304	330	370	270	273	291	182	302	337	340	267	149	263
October...	301	334	372	455	341	356	361	255	584	360	454	317	340	385
November	363	285	416	655	388	487	432	341	299	390	637	405	504	429
December.	133	118	57	173	119	455	176	131	114	54	135	132	456	170
Year....	2,913	2,587	2,734	3,064	2,767	2,925	2,834	2,516	2,824	2,720	2,870	2,564	2,877	2,729

	Basin above Alhajuela.							Basin Alhajuela–Gamboa.						
January..	.....	151	100	19	254	15	108	.....	151	36	7	180	11	77
February.	.....	104	5	13	12	6	28	.....	104	3	4	7	3	24
March....	.....	33	15	44	35	18	29	.....	33	2	25	60	9	26
April.....	.....	24	62	51	128	27	58	.....	24	93	42	192	12	73
May.....	.....	285	285	280	**284**	287	284	....	285	215	340	**270**	240	270
June.....	.....	193	374	293	204	273	267	.....	193	381	250	195	275	259
July.....	.....	500	464	227	376	462	406	.....	269	421	218	242	421	314
August...	.....	317	351	386	193	381	326	.....	269	247	403	227	363	302
September	.....	313	337	353	275	254	306	.....	273	337	309	248	224	278
October...	.....	342	376	443	322	325	362	.....	252	322	463	307	374	344
November	.....	321	427	689	399	567	480	.....	247	305	515	429	358	369
December.	.....	138	67	131	152	463	190	.....	58	25	147	86	439	151
Year....	.....	2,721	2,863	2,929	2,634	3,078	2,844	.....	2,158	2,387	2,723	2,414	2,731	2,487

	Basin Gamboa–Bohio.						
January..	192	182	102	25	453	52	168
February.	17	79	8	24	14	5	25
March....	39	59	15	33	67	19	39
April.....	152	32	77	33	186	48	85
May.....	253	240	180	353	**259**	265	258
June.....	310	299	389	251	151	244	274
July.....	687	346	396	367	152	312	377
August...	745	304	291	484	212	304	390
September	221	284	314	412	271	316	303
October...	469	346	388	447	276	352	380
November	462	243	453	677	349	417	434
December.	112	113	61	233	95	415	171
Year....	3,657	2,527	2,674	3,339	2,464	2,749	2,904

OUTFLOW FROM THE BASIN ABOVE BOHIO.

Although measurements to determine the discharge of the Chagres at Gamboa and at Bohio were by no means neglected by the engineers of the old company, they have been made with much more system since the work devolved upon the receiver, and later upon the new company. The chief stations have been Gamboa and Bohio and finally Alhajuela. As a result, a definite knowledge has been secured of the monthly discharges at the two first-named stations since January, 1890, and at Alhajuela since January, 1895, except for a few months when the work was suspended.

These measurements have been made carefully by the method of floats, supplemented by self-registering water gages recording continuously the water level of the river. The discharge measurements have been made sometimes daily and sometimes on every third day, with frequent additions during freshets. Nevertheless, in a stream so subject to frequent oscillations involving excessive variations in the volume transported, the only satisfactory mode of estimating the continuous discharge is to study the relation between the height of the water surface and the corresponding volumes, and thus deduce rating tables from which the discharge at short intervals, every two hours, can be determined. This has been done with great care at each of the three stations, and at each the result has been to show that two rating scales should be framed, one applicable to the river when the surface is sensibly unchanging in level, and the other applicable to sudden freshets when a huge wave sweeps down the channel. All rivers under such conditions carry at any fixed level a much larger volume when rising than when falling, and this difference must be taken into account by adjusting the rating tables to indicate the average volume at each level. The great number of actual gagings has rendered this adjustment a simple matter, and rating tables wholly independent of each other have thus been derived for the three stations. They are shown by the following formulæ, that for Alhajuela based on 1599 gagings; that for Gamboa on 2147 gagings; and that for Bohio on 1854 gagings. They have been framed either by the method of least squares or by an algebraic study of the platted curves representing the observations. The latter method has generally proved to be the most satisfactory, since it recognizes the general law of continuity while the former tends to follow the accidental departures from it of the observations themselves, often giving a slightly wavy curve. No arbitrary drawing of any part of the scale has been employed. In these formulæ Q denotes the discharge in cubic meters per second, and C the height of water surface above mean sea level.

(3) Alhajuela, $Q = -6 + 52\ (C - 27.5)^2 - 1.6\ (C - 27.5)^3$; level sensibly unchanging.

(4) Alhajuela, $Q = -7 + 110\ (C - 28) + 40\ (C - 28)^2 - 1.8\ (C - 28)^3$; rapid changes of level.

(5) Gamboa, $Q = -24 + 24\ (C - 13) + 18\ (C - 13)^2 - 0.5\ (C - 13)^3$; sensibly unchanging.

(6) Gamboa, $Q = -26 + 40\ (C - 13) + 18\ (C - 13)^2 - 0.5\ (C - 13)^3$; rapid changes of level.

(7) Bohio, $Q = 47C + 5C^2 + C^3$; level sensibly unchanging.

(8) Bohio, $Q = 62C + 5C^2 + C^3$; rapid changes of level.

A comparison of the volumes thus computed from day to day at the three stations leaves no doubt as to the precision of this method of determining the relative and hence, probably, the absolute discharge. Based on wholly independent data these volumes are found to be in perfect accord with each other, showing during quiet stages discharges slightly increasing from station to station as the intermediate tributaries enter, and during freshets indicating the passage of the wave in a clear and natural manner. Of late years this method by rating tables and automatically recorded river stages has been uniformly followed in estimating the average monthly volumes; but for some of the months prior to 1898, when hourly water height records are lacking, the estimated volumes represent the means of the actual gagings, or in a few rare instances discharges measured at the adjacent station and transferred by well established ratios, for determining which the data are ample. The Engineering Magazine for December, 1902, gives the volumes since 1890. The following table exhibits in cubic meters per second the average monthly discharges for which

corresponding rain records are available. The outflowing volumes from the three subbasins are estimated from those measured at the three gaging stations, or rather from the differences between them.

TABLE 2.—*Outflow, in cubic meters per second, from the basin of the Chagres.*

Month.	Basin above Bohio.							Basin above Gamboa.						
	1898.	1899.	1900.	1901.	1902.	1903.	Means.	1898.	1899.	1900.	1901.	1902.	1903.	Means.
January ..	160	109	60	42	318	46	122.5	122	99	48	29	148	46	82.0
February .	48	49	30	28	59	29	40.5	42	27	23	19	45	26	30.0
March	31	28	21	20	36	18	25.7	29	27	15	13	29	20	22.2
April	57	31	20	16	61	16	33.5	52	30	16	13	55	20	31.0
May	76	58	46	65	58	43	57.6	70	54	38	50	51	43	51.0
June.....	95	89	81	79	90	72	84.3	81	70	55	58	82	61	67.8
July	186	112	159	90	86	114	124.5	120	80	95	62	85	94	89.3
August ...	150	162	149	122	96	155	139.0	117	120	101	81	79	123	103.5
September	91	120	135	164	111	161	130.3	72	90	87	166	83	133	94.7
October...	143	140	198	179	168	158	164.3	98	96	128	105	125	112	110.7
November	222	150	187	375	189	236	226.5	147	106	115	191	134	162	142.5
December.	81	102	106	130	85	297	133.5	65	75	76	89	62	199	94.3
Means .	112	96	99	109	113	112	106.8	85	73	66	68	81	87	76.6

Month.	Basin above Alhajuela.							Basin Alhajuela–Gamboa.						
	1898.	1899.	1900.	1901.	1902.	1903.	Means.	1898.	1899.	1900.	1901.	1902.	1903.	Means.
January ..	.....	*90	45	28	120	32	63.0	.....	9	3	1	28	14	11.3
February .	.....	*24	23	19	36	24	25.2	.....	3	0	0	9	1	2.6
March	.....	*24	15	13	23	14	17.8	.....	3	0	0	6	6	2.8
April	.....	25	16	13	48	16	23.6	.....	5	0	0	7	4	3.2
May	.....	45	38	44	40	37	40.1	.....	9	0	6	5	5	5.0
June.....	.....	61	44	49	62	55	54.2	.....	9	11	9	20	7	11.2
July	.....	63	62	56	69	88	65.8	.....	17	33	6	25	5	17.2
August ...	.....	93	80	69	66	90	79.6	.....	27	21	12	13	33	21.2
September	.....	68	61	83	67	79	71.6	.....	22	26	30	16	54	27.6
October...	.....	75	91	78	91	78	82.6	.....	21	37	27	34	34	30.6
November	.....	83	84	135	89	139	106.0	.....	23	31	56	45	23	35.6
December.	.....	64	65	86	52	155	84.4	.....	11	11	3	10	44	15.9
Means .	.....	60	52	56	63	67	59.5	.....	13	14	12	18	19	15.3

Month.	Basin Gamboa–Bohio.						
	1898.	1899.	1900.	1901.	1902.	1903.	Means.
January ..	38	10	12	13	170	0	40.5
February .	6	22	7	9	14	3	10.2
March	2	1	6	7	7	0	3.8
April	5	1	4	3	6	0	3.2
May	6	4	8	15	7	0	6.6
June.....	14	19	26	21	8	11	16.5
July	66	32	64	28	1	20	35.2
August ...	33	42	48	41	17	32	35.5
September	19	30	48	61	28	27	35.5
October...	45	44	70	74	43	46	53.7
November	75	44	72	184	55	74	84.0
December.	16	27	30	41	28	98	40.0
Means .	27	23	33	41	32	26	30.4

*Outflow for January, February, and March, 1899, estimated from that measured at Gamboa, the ratio being well known. Black figures for May, 1902, indicate interpolations.

A comparison of these figures with those for the preceding years will make it apparent that the river has recently been passing through a phase of minimum discharge, and it becomes a matter of interest to push the inquiry further in order to fully understand the regimen. Fortunately, this can be done from the fluviograph record of water heights at Gamboa.

The instrument was established there in 1882, and a nearly complete record has been kept since that date. It is lacking for the year 1889, when the old canal company ceased operations, and for some months in 1896 and 1897, for which the sheets were, unfortunately, lost. This leaves available three 6-year epochs (1883–1888, 1890–1895, and 1898–1903), for which have been accurately noted for each month the number of freshets and the total number of hours when the river rose above a level about 10 feet above the low-water stage (17 meters above mean tide). This level is the standard from which freshets are estimated. Below it the Chagres at Gamboa is a quiet stream, with a volume ranging from about 500 to about 11,500 cubic feet per second; above it the discharge often attains 30,000 or 35,000 cubic feet, and in great floods a maximum of nearly 80,000 cubic feet. A knowledge of the number and duration of the freshets gives, therefore, a good general idea of the relative discharge in different months and years.

The following table presents this information consolidated in 6-year groups, together with the corresponding local rainfall at Gamboa. These 6-year epochs are all complete, except for the river data in October, 1887, and May, 1902, and the local rainfall for the year 1895; for January and February, 1883; for January, 1884, and for May, 1902. The sign + following a figure in the table indicates that one month is missing, and, hence, that approximately one-fifth part should be added when comparing it with other months. This correction has been made in the averages.

TABLE 3.—*Number and duration of freshets at Gamboa, with corresponding local rainfall.*

Month.	Totals in 1883–1888.			Totals in 1890–1895.			Totals in 1898–1903.			Average freshet hours in 6 yrs.
	Freshets.	Hours.	Rainfall.	Freshets.	Hours.	Rainfall.	Freshets.	Hours.	Rainfall.	
January.....	0	0	3.0+	3	27	8.0+	7	108	23.3	45
February.....	0	0	2.7+	0	0	2.3+	0	0	2.5	0
March.....	1	9	1.7+	0	0	6.1+	0	0	6.5	3
April.....	3	19	21.4	3	28	18.5+	2	21	16.7	23
May.....	10	201	74.2	17	136	60.4+	3+	23+	42.6+	122
June.....	27	206	76.8	7	54	49.0+	3	5	50.8	88
July.....	22	179	54.2	20	161	56.5+	6	35	70.3	125
August	33	299	93.7	16	101	54.6+	11	67	75.1	156
September.....	31	322	63.6	6	47	58.5+	2	10	53.5	126
October	26+	217+	79.8	13	108	80.0+	7	52	70.0	126
November.....	25	423	82.8	12	158	55.4+	18	183	79.4	255
December	20	810	53.1	21	465	46.5+	8	51	28.7	442
Totals.....	203	2,728	608.5	118	1,285	595.0	68	560	527.7	1,511
Annual	34	455	101.6	20	214	99.2	11	93	88.0	252

It should not be forgotten in comparing these three groups that the first includes two flood years (1885 and 1888) and the second two flood years (1890 and 1893), while the third has none, but as these floods affect only the months of November and December, the evidence is still conclusive that the present is a period of exceptionally low water, caused by a rainfall below the general average. The investigations of the Isthmian Canal Commission have demonstrated that similar variations covering several years have occurred in Nicaragua, but there seems to be no annual correlation between the two districts. The fact, however, that the present is a low-water epoch for the Chagres should be borne in mind in considering the following analysis.

EVAPORATION, PLANT ABSORPTION, AND PERCOLATION.

There being no natural lakes in the basin of the Chagres, no attempt has been made to measure evaporation from exposed water surfaces. A study of all available records where the conditions are approximately similar led the Comité Technique of the New Panama Canal Company to adopt, as the probable evaporation from the projected artificial lakes and the water surface of the canal, 6 millimeters (0.24 inches) per twenty-four hours, adding for possible infiltration an equal amount.

In Nicaragua, where evaporation is an important element in the problem of water supply for a canal, careful measurements were made by the Isthmian Canal Commission, both by the methods of pans floating in the lake and by comparative studies of lake level as affected by rainfall, inflow, and outflow through the channel of the San Juan River. The conclusions are thus summed up by Mr. A. P. Davis, the hydrographer of the commission:

Observations by the pan method were made in 1898, 1899, and 1900, some of them covering an entire year. The results ranged from a maximum of 8.13 inches in April, 1898, to a minimum of 2.02 inches in September, 1899, the grand average for ninety-four months being 4.28 inches per month, or about 0.18 inch in twenty-four hours. He notes that the results were rather discordant, and, moreover, that the conditions affecting the pans did not duplicate those affecting the lake, where: "Except along the eastern shore the surface of the lake is thrown into billows, the waves often attaining a considerable height and being crowned with whitecaps, and the total water surface in contact with the wind is much greater

than the level surface of the lake. Most of the lake surface must, therefore, lose by evaporation a greater depth of water than the pan." Recourse was therefore had to the second method, based during the dry seasons of 1900 and 1901 on the observed lake level, the rain records at eight stations, the estimated inflow, and the measured outflow by the San Juan River. The results in inches per twenty-four hours were as follows: For February, 1900, 0.21; for March, 0.22; for April, 0.18; for first half of May, 0.21. For the second year (1901) the figures were, in February, 0.12; in March, 0.13; in April, 0.26. The grand mean was thus found to be 0.19 inch in twenty-four hours, which, it will be noted, is slightly less than that assumed by the Comité Technique for the basin of the Chagres, but is in good accordance therewith.

What is specially involved in the present problem is not evaporation from exposed water surfaces, but that from the general surface of the basin. Existing data in tropical regions are insufficient to permit a numerical estimate of the latter, but it is well known that the essential elements upon which it depends are the relative volume of aqueous vapor already held in suspension in the atmosphere, the capacity for which is largely increased as the temperature rises, the greater or less agitation due to winds, the absolute atmospheric pressure acting inversely, and the nature of the surfaces presented to the air. The known conditions existing in the basin of the Chagres render it fair to assume that evaporation there must be extremely uniform throughout the rainy months of the year, and that it can not be excessive in amount. Thus, the hygrometric observations at Colon made by the old canal company in 1881, and those by the United States Weather Bureau in 1898, concur in indicating a relative humidity ranging within narrow limits from 0.80 in the dry months to 0.87 in the rainy season. The winds of the Isthmus are gentle, rarely attaining a velocity of 10 miles an hour. The surface of nearly the entire region is covered by a dense tropical growth impenetrable to the rays of the sun or to rapid movements of the atmosphere. The barometric pressure is so nearly uniform that continuous observations covering the last four and a half years at Alhajuela show an extreme variation of only 0.43 inch, of which about 0.1 of an inch is represented by the normal diurnal oscillation. Finally, the temperature of the air hardly varies from month to month, or from place to place, throughout the entire Isthmus, as is shown by the following 5-year records at Alhajuela and La Boca, confirmed by the aggregate records of about twenty-six years at Colon, Gamboa, Alhajuela, Panama, La Boca, and Naos, ending December, 1902:

TABLE 4.—*Observed air temperatures on the Isthmus.*

Month.	Alhajuela, 51 months.			La Boca, 53 months.			General average, 308 months.		
	Months.	° *F.*	° *C.*	*Months.*	° *F.*	° *C.*	*Months.*	° *F.*	° *C.*
January	4	78.01	25.56	4	79.34	26.30	25	78.28	25.71
February	3	79.74	26.52	4	80.37	26.87	24	78.51	25.84
March	3	80.10	26.72	4	80.94	27.19	25	79.21	26.23
April	4	81.25	27.36	4	81.77	27.65	26	80.31	26.84
May	3	79.00	26.11	3	80.19	26.77	24	80.33	26.85
June	4	79.67	26.48	4	80.74	27.08	24	81.01	27.23
July	5	79.18	26.21	5	79.92	26.63	26	80.44	26.91
August	5	79.65	26.47	5	78.89	26.05	26	79.93	26.63
September	5	79.51	26.39	5	79.34	26.30	26	80.28	26.82
October	5	78.78	25.99	5	78.53	25.84	27	79.38	26.32
November	5	78.62	25.90	5	77.97	25.54	27	79.12	26.18
December	5	78.93	26.07	5	79.11	26.17	28	79.11	26.17
Year		79.37	26.32		79.76	26.53		79.66	26.48

These facts, confirmed by the above measurements of evaporation from water surfaces in Nicaragua, which do not materially differ from similar series under like rainfall in temperate regions, support the assumption that whatever influence may be exerted by evaporation in the catchment basin of the Chagres, it must be sensibly constant throughout the rainy months of the year and, therefore, will not exert any considerable disturbing influence upon the ratio between downfall and drainage in those months. The same may be affirmed respecting the influence of plant life as it exists on the Isthmus. As already stated, these advantages, together with the absence of ice and snow, greatly facilitate the study of ground water as a function of this ratio, which became one of the special objects of these investigations from its bearing upon possible percolation from the artificial lakes.

GROUND-WATER FLOW.

The study of the flow of water in natural channels involves no slight difficulties, as is well known to hydraulic engineers, but the problems offered by the passage through the soil of that part of the rainfall that ultimately finds its way to the sea by that route is rendered far more complex by the variety of the materials to be traversed, and by the addition of two new motive forces to the action of gravity when the laws governing transmission are to be considered. These two forces are capillarity and thermal pressure as affecting both the fluid itself and the more or less compressible materials through which it finds its devious route. Much progress has recently been made by experimental researches on the rate of flow through different materials, but the difficulty of certainly ascertaining the nature of these materials, and the possible existence of fissures impossible to take into account, render too hazardous any attempt to make a practical application of these researches in any particular case. The general fact that water penetrates to depths of perhaps two miles and is in constant movement through the earth's crust has been established beyond question by different lines of investigation, and notably by the fact that some streams increase very sensibly their volume in traversing districts where they receive no visible contributions; but the application of any theory of motion to particular cases has hardly yet been reached in engineering practise.

In the case of the Panama Canal the question of ground water was raised by the claim of the opponents of this route that the creation of artificial lakes by damming the stream might be rendered futile by reason of excessive percolation through the soil to be submerged. The same objection might be raised a priori against any proposed reservoir; and the geological formation of the Valley of the Chagres offers every reason for believing that no such result is to be apprehended. Nevertheless, since stream flow is a function of rainfall, evaporation, plant absorption, and ground water, and since two of these variables must have nearly constant values in the Valley of the Chagres, it seemed possible that a prolonged study of the ratio between the rainfall and the volume flowing in the valley of the stream might throw further light upon the problem. If the result indicated that little or no ground water found its way to the river the possible existence of an underground flow dangerous to an artificial lake would be suggested. If, on the contrary, the volume received through the earth should prove to be considerable, there would remain little or no danger of serious escape from the lakes. The sharp division of the year into rainy and dry seasons would render the study of the ratio decisive on this question. Careful investigations have been in progress since January, 1898, and the preliminary results appeared in the MONTHLY WEATHER REVIEW for June, 1900. Since that date the measurements have been continuous, and have now reached a point where it is believed that the evidence is conclusive that no important loss of water from the lakes is to be feared. Ground water has been demonstrated to be a very important element of the volume carried by the river.

RATIO BETWEEN DOWNFALL AND DRAINAGE.

The available data, contained in Tables 1 and 2, have allowed the ratio between downfall and drainage to be studied during a period of six years for the entire basin, for the two subbasins above Gamboa jointly, and for the lower subbasin, and separately during five years for the two upper subbasins. The general formula for the entire basin, taking into account the areas of the three subbasins, is the following, in which the

letters A, C, G, and B denote, in meters, the rainfall at the four observing stations of which they are the initials, Q denotes the outflow in cubic meters per second at Bohio, D denotes the number of days for which rainfall and outflow are considered, and R denotes the desired ratio.[1] The numerical constant correlates the mile and meter units. The computations have been made for calendar months, periods sufficiently long to usually eliminate discrepancies resulting from the time elapsed between precipitation and direct outflow, which observation has shown to vary from twenty-four to forty-eight hours according to the locus of the rainfall. The formulæ for the separate subbasins are easily derived from the general expression which is the following:

$$(9) \qquad R = \frac{Q \times 3600 \times 24 \times D}{1610^2\left(\frac{250\,(B+G)}{2} + \frac{130\,(G+A)}{2} + \frac{320\,(A+C)}{2}\right)}$$

For making the computations this general expression may be placed under the following more convenient form, in which the unit for A, C, G, and B remains the meter, and n represents unity for a month of thirty days, 1.034 for one of thirty-one days, and 0.934 for one of twenty-eight days.

$$(10) \qquad R = \frac{n\,Q}{125\,(B+G) + 65\,(G+A) + 160\,(A+C)}$$

Similar reductions may be made for computing the ratio for the separate subbasins. The following table represents the results of these several computations applied to the foregoing data. It should be stated that the columns of "means" are not the numerical averages of the ratios for the different years, but are the quotients found by dividing the sums of the corresponding values of the numerator of formula (10) by the sums of the corresponding values of its denominator. The "general average" in like manner is computed from the "means" of the five basins, upon the same principle.

Figs. 1–5 have been designed to present clearly to the eye the relative values of the more important data of Tables 1, 2, 4, and 5 as exhibited in each of the five basins under consideration. Their general conformity is manifest throughout the entire catchment area.

TABLE 5.—*Ratio between downfall and drainage in the basin of the Chagres.*

Month.	Above Bohio, six years.							Above Gamboa, six years.						
	1898.	1899.	1900.	1901.	1902.	1903.	Means.	1898.	1899.	1900.	1901.	1902.	1903.	Means.
January	1.79	0.99	1.00	3.28	1.10	4.38	1.26	2.83	1.50	1.35	4.29	0.82	7.46	1.91
February	6.33	0.67	7.13	2.50	6.89	7.94	2.33	14.52	5.36	11.12	3.98	8.96	10.66	2.69
March	1.72	0.97	3.50	0.81	1.04	1.62	1.24	3.83	1.88	3.06	0.77	1.59	3.04	1.90
April	0.75	1.26	0.39	0.53	0.54	0.75	0.65	1.48	2.83	0.50	0.60	0.83	1.93	1.06
May	0.47	0.32	0.29	0.30	.....	0.24	0.32	0.70	0.29	0.33	0.39	.....	0.36	0.43
June	0.48	0.55	0.30	0.42	0.70	0.39	0.44	0.12	0.96	0.33	0.43	0.90	0.50	0.57
July	0.48	0.41	0.54	0.47	0.47	0.42	0.46	0.49	0.42	0.48	0.64	0.58	0.48	0.51
August	0.44	0.81	0.71	0.43	0.59	0.65	0.58	0.68	0.95	0.72	0.48	0.89	0.75	0.72
September	0.66	0.58	0.59	0.64	0.59	0.85	0.65	0.88	0.66	0.57	0.67	0.69	1.21	0.80
October	0.65	0.63	0.79	0.59	0.73	0.68	0.68	0.88	0.70	0.82	0.54	0.90	0.76	0.66
November	0.84	0.77	0.65	0.83	0.70	0.71	0.75	0.96	0.79	0.65	0.67	0.74	0.71	0.74
December	0.96	1.32	2.74	1.13	1.05	0.99	1.14	1.14	1.50	3.18	1.51	1.07	1.00	1.16

Month.	Above Alhajuela, five years.							Alhajuela-Gamboa, five years.						
January	.....	1.90	1.45	4.76	0.94	6.80	1.89	.....	0.53	0.66	1.14	0.54	10.20	1.14
February	.....	0.67	13.42	4.43	8.75	14.24	2.63	.....	0.21	*	*	9.94	1.87	0.79
March	.....	2.35	3.23	0.95	2.15	2.66	2.06	.....	0.72	*	*	0.79	4.97	0.86
April	.....	3.32	0.81	0.80	1.17	1.80	1.27	.....	1.64	*	*	0.13	2.61	0.33
May	.....	0.51	0.43	0.51	.....	0.44	0.46	.....	0.25	*	0.14	.....	0.16	0.15
June	.....	0.99	0.37	0.52	0.95	0.63	0.63	.....	0.36	0.23	0.28	0.79	0.19	0.33
July	.....	0.41	0.43	0.79	0.52	0.62	0.52	.....	0.50	0.62	0.22	0.81	0.10	0.44
August	.....	0.95	0.74	0.58	1.10	0.76	0.79	.....	0.80	0.67	0.22	0.47	0.72	0.56
September	.....	0.68	0.57	0.74	0.76	0.98	0.73	.....	0.62	0.60	0.50	0.50	1.85	0.76
October	.....	0.71	0.78	0.57	0.91	0.76	0.74	.....	0.59	0.91	0.46	0.88	0.72	0.71
November	.....	0.81	0.62	0.61	0.70	0.77	0.69	.....	0.72	0.78	0.84	0.92	0.49	0.74
December	.....	1.49	3.13	2.13	1.00	1.08	1.44	.....	1.51	3.57	0.16	0.93	0.79	0.83

Month.	Gamboa–Bohio, six years.							General average of the five basins.						
January	0.82	2.26	0.48	2.15	1.55	*	1.00	.....	.....	.....	.....	.....	.....	1.38
February	1.28	1.04	3.27	1.40	3.96	2.49	1.53	.....	.....	.....	.....	.....	.....	1.94
March	2.22	0.07	1.71	0.88	0.44	*	0.40	.....	.....	.....	.....	.....	.....	1.20
April	0.12	0.02	0.21	0.36	0.28	*	0.15	.....	.....	.....	.....	.....	.....	0.51
May	0.10	0.07	0.18	0.18	.....	*	0.11	.....	.....	.....	.....	.....	.....	0.30
June	0.18	0.25	0.27	0.34	0.21	0.17	0.24	.....	.....	.....	.....	.....	.....	0.44
July	0.40	0.38	0.67	0.31	0.03	0.27	0.39	.....	.....	.....	.....	.....	.....	0.47
August	0.18	0.57	0.68	0.35	0.23	0.44	0.38	.....	.....	.....	.....	.....	.....	0.59
September	0.34	0.42	0.61	0.59	0.41	0.35	0.47	.....	.....	.....	.....	.....	.....	0.69
October	0.40	0.52	0.75	0.68	0.47	0.55	0.59	.....	.....	.....	.....	.....	.....	0.67
November	0.65	0.73	0.64	1.11	0.63	0.71	0.78	.....	.....	.....	.....	.....	.....	0.74
December	0.59	0.99	2.03	0.73	1.00	0.98	0.94	.....	.....	.....	.....	.....	.....	1.14

* No outflow from basin, reducing the ratio to zero.

CONCLUSIONS RESULTING FROM THE ANALYSIS.

To facilitate a study of these data it has seemed to be desirable to consolidate them, and to present the outflow and rainfall in English units, giving the former in the double form both of cubic feet per second and of the height in inches to which 1 square mile would be flooded by the flow. Under the latter form a direct comparison between the figures for outflow and rainfall, and between the different divisions of the basin can be made, since varying areas are eliminated. This arrangement is carried out in Table 6, to which is added for comparison the outflow for as many months as have been well determined, together with the ratios as given in Table 5.

Table 6 reveals numerous important facts as to the regimen of the Chagres. Thus, a comparison between the outflow, expressed in inch-miles, during the period for which corresponding rainfall records are available and during the longer periods for which the outflow only is known, shows a well-marked correspondence throughout the entire year, the only discrepancy being for the month of May, and this variation is explained by exceptional freshets which occurred in 1890, 1891, 1892, and 1896. Furthermore, it confirms the inference suggested by Table 3 that this region is now passing through an epoch of minimum rainfall and outflow, since the longer periods indicate a larger outflow.

Again, on comparing month by month the known rainfall and outflow in inch-miles, all five basins are in accord in showing a normal variation. To present this more clearly to the eye, it is illustrated by two curves in fig. 6. The rainfall is at its minimum in February; begins to increase rapidly in April, when the sun is passing the zenith, moving northward; experiences a slight reduction in June, when at the summer solstice the northern limit is reached; passes a first maximum in July or August, about the time of the second zenith passage; and, finally, after a slight reduction in September, when the ascending current of air moves southward from the Isthmus, attains the maximum for the year in November, when the sun is lingering near the winter solstice and the moisture-laden winds from the Gulf of Mexico are sweeping over the Isthmus. The outflow curve on fig. 6 demonstrates that this annual sequence is by no means reproduced in the outflow from the basin of the Chagres. The minimum for the year occurs in February or March, and the volume steadily increases until November, with only a slight augmentation to mark the July-August epoch. The explanation of this clearly-defined difference between the two curves must be sought in the ground-water flow revealed by a study of the monthly ratios between downfall and drainage, as will appear below.

Before leaving this important Table 6, it is well to note that the annual average rainfall in the three subbasins shows a maximum of 114.54 inches in the lower, a next larger figure of 111.91 inches in the upper, and a minimum of 98.08 inches in the middle or Alhajuela-Gamboa division. Such differences are naturally to be expected from their geographical positions relative to the Atlantic coast and the well-known reduction in rainfall as the Pacific is approached; but on comparing the corresponding outflow, another variation is apparent. The three values of the outflow corresponding to the above rainfall are, respectively, 4.88 inch-miles, 7.46 inch-miles, and 4.73 inch-miles. This matter will also be considered below.

The ratio between downfall and drainage will now be studied in detail. Except during the dry season, when ground water

[1] i. e. the ratio of the volume of rainfall to that of outflow.

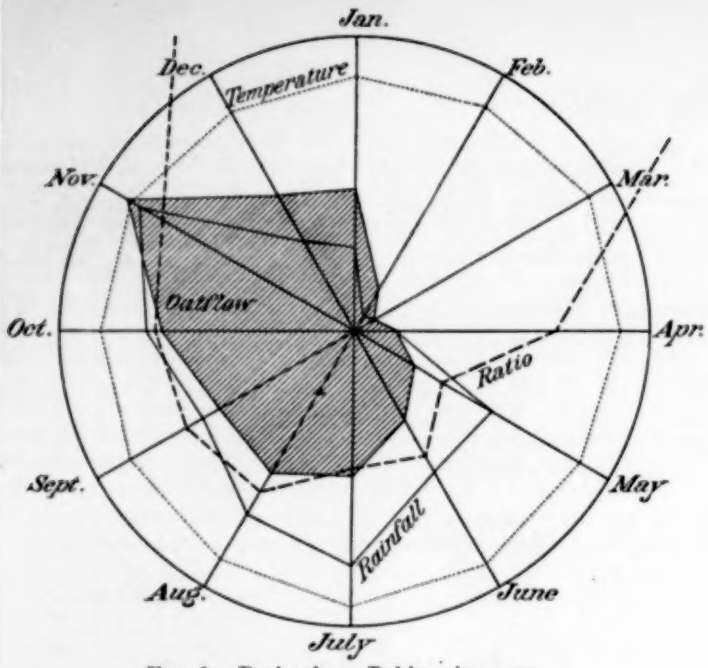

FIG. 1.—Basin above Bohio, six years.

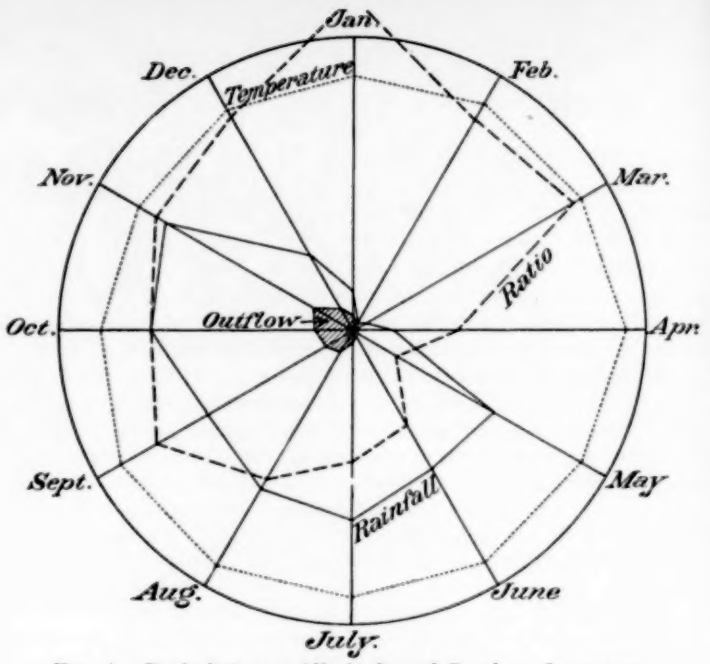

FIG. 4.—Basin between Alhajuela and Gamboa, five years.

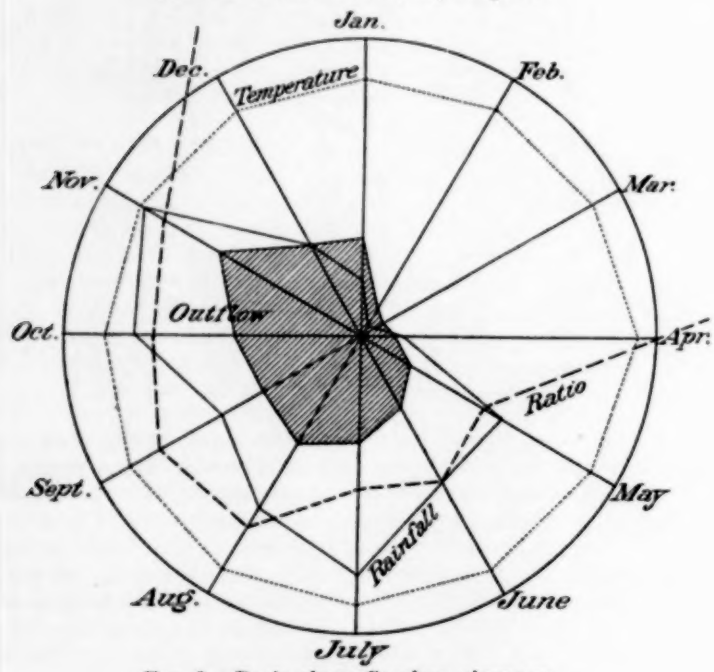

FIG. 2.—Basin above Gamboa, six years.

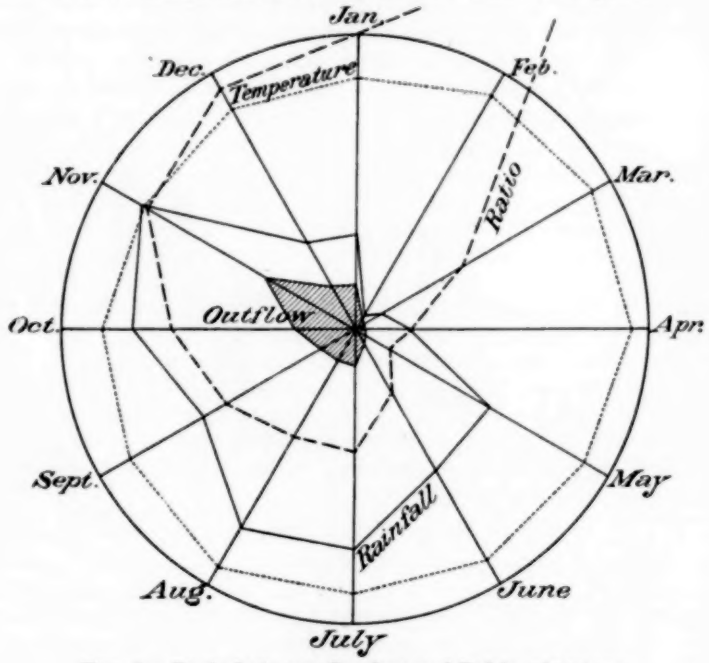

FIG. 5.—Basin between Gamboa and Bohio, six years.

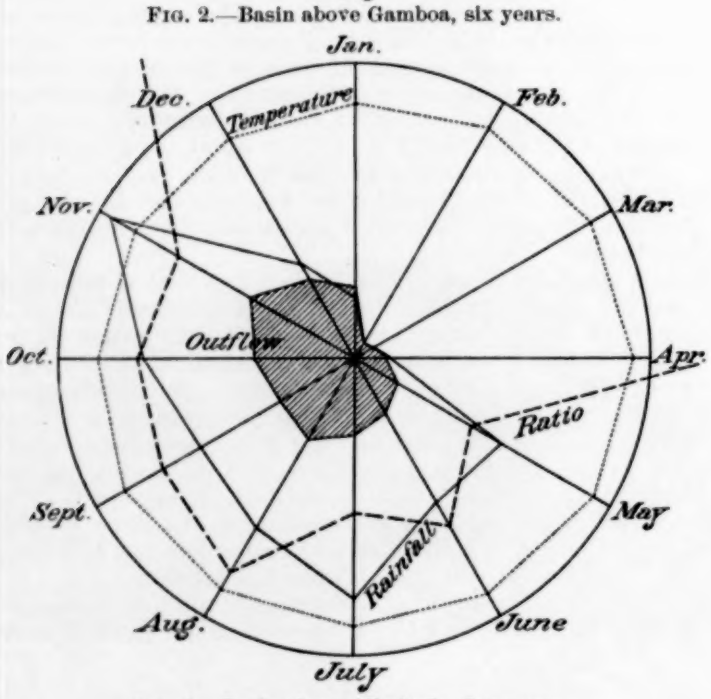

FIG. 3.—Basin above Alhajuela, five years.

FIGS. 1–5.—Hydrology of the basin of the Chagres at Alhajuela, Gamboa, and Bohio. Annual variation in average temperature, rainfall, outflow, and ratio between the two latter. The radius of the circle indicates 30° C. of temperature; 500 millimeters of rainfall; 250 cubic meters per second of outflow and a ratio of unity between the rainfall and outflow, both expressed in cubic meters. The figures here plotted are as follows: Temperatures, from Table 4, column 4; rainfall, from Table 1, column of means; outflow, from Table 2, column of means; ratio, from Table 5, column of means.

TABLE 6.—*Average rainfall and outflow in the Valley of the Chagres.*

Month.	Outflow in foot-seconds.			Outflow in inch-miles.			Rainfall, inches.		Mean ratio.
	5 years.	6 years.	14 yrs.	5 years.	6 years.	14 yrs.	5 years.	6 years.	
Basin above Bohio, 700 square miles.									
January	4,061	4,327	4,065	6.69	7.13	6.70	5.85	5.78	1.26
February	1,377	1,430	1,546	2.05	2.09	2.30	1.34	1.06	2.33
March	869	908	986	1.43	1.50	1.63	1.37	1.34	1.24
April	1,020	1,183	1,391	1.63	1.89	2.22	2.67	2.95	0.65
May	1,906	2,034	3,986	3.14	3.35	6.56	10.69	10.47	0.32
June	2,903	2,977	4,001	4.63	4.74	6.38	10.51	10.63	0.44
July	3,979	4,397	5,484	6.55	7.24	9.04	14.03	15.51	0.46
August	4,831	4,909	6,160	7.95	8.08	10.15	12.87	14.21	0.58
September	4,877	4,602	5,860	7.77	7.33	9.34	12.18	11.45	0.65
October	5,961	5,802	7,028	9.82	9.56	11.58	14.63	14.21	0.68
November	8,032	8,000	8,592	12.79	12.76	13.70	17.57	17.01	0.75
December	5,086	4,717	7,445	8.38	7.77	12.26	7.26	6.92	1.14
Year	3,742	3,774	4,712	72.83	73.44	91.86	110.97	111.54	.....
Basin above Gamboa, 450 square miles.									
January	2,611	2,896	2,657	6.70	7.43	6.80	3.89	3.90	1.91
February	987	1,059	1,228	2.28	2.45	2.26	1.04	0.91	2.69
March	734	784	842	1.88	2.01	2.16	1.09	1.06	1.90
April	943	1,095	1,215	2.34	2.71	3.01	2.46	2.56	1.06
May	1,670	1,801	2,913	4.28	4.61	7.46	10.94	10.63	0.43
June	2,305	2,394	2,907	5.81	5.93	7.21	10.42	10.43	0.57
July	2,935	3,154	3,808	7.52	8.08	9.76	14.90	15.79	0.51
August	3,806	3,655	3,971	9.75	9.36	10.17	12.54	13.07	0.72
September	3,506	3,344	3,757	8.69	8.29	9.32	10.98	10.35	0.80
October	3,989	3,909	4,304	9.95	10.02	11.04	16.18	15.16	0.66
November	5,001	5,033	5,082	12.40	12.48	12.62	17.60	16.89	0.74
December	3,539	3,330	4,873	9.06	8.53	12.49	7.01	6.69	1.16
Year	2,670	2,705	3,130	80.66	81.90	94.30	109.05	107.44	.....
Lower subbasin (Gamboa-Bohio), 250 square miles.									
January	1,450	1,430	1,408	6.69	6.60	6.49	6.40	6.61	1.00
February	390	360	318	1.62	1.50	1.33	1.02	0.98	1.53
March	135	134	144	0.62	0.62	0.68	1.52	1.54	0.40
April	77	113	176	0.35	0.50	0.78	2.96	3.35	0.15
May	236	233	1,073	1.08	1.07	4.90	10.20	10.15	0.11
June	598	583	1,094	2.67	2.60	4.89	10.50	10.84	0.24
July	1,044	1,243	1,676	4.82	5.73	7.74	12.38	14.82	0.39
August	1,025	1,254	2,189	4.73	5.79	10.10	12.56	15.35	0.38
September	1,371	1,254	2,103	6.12	5.60	9.39	12.57	11.93	0.47
October	1,963	1,896	2,724	9.06	8.75	12.57	14.24	14.96	0.59
November	3,031	2,967	3,510	13.51	13.25	15.68	16.84	17.09	0.78
December	1,547	1,413	2,572	7.13	6.52	11.57	7.22	6.92	0.94
Year	1,072	1,074	1,582	58.40	58.53	86.42	108.41	114.54	.....
Middle subbasin (Gamboa-Alhajuela), 130 square miles.									
	5 years.	7 years.	14 yrs.	5 years.	7 years.	14 yrs.	5 years.	6 years.	Ratio
January	388	293	.....	3.44	2.59	.....	3.03	.....	1.14
February	92	133	.....	0.74	1.07	.....	0.94	.....	0.79
March	99	129	.....	0.88	1.14	.....	1.02	.....	0.86
April	113	96	.....	0.97	0.76	.....	2.97	.....	0.33
May	177	764	.....	1.57	6.78	.....	10.63	.....	0.15
June	396	746	.....	3.39	6.40	.....	10.19	.....	0.33
July	607	697	.....	5.39	6.18	.....	12.36	.....	0.44
August	749	778	.....	6.64	6.90	.....	11.89	.....	0.56
September	975	993	.....	8.37	8.53	.....	10.94	.....	0.76
October	1,081	1,049	.....	9.59	9.31	.....	13.54	.....	0.71
November	1,257	1,145	.....	10.80	9.84	.....	14.53	.....	0.74
December	558	873	.....	4.95	7.74	.....	5.94	.....	0.83
Year	541	641	.....	56.73	67.24	.....	98.08	.....	.....
Upper subbasin (above Alhajuela), 320 square miles.									
January	2,225	2,395	.....	8.02	8.58	.....	4.25	.....	1.89
February	890	945	.....	2.89	3.07	.....	1.10	.....	2.63
March	629	643	.....	2.27	2.32	.....	1.10	.....	2.06
April	833	931	.....	2.90	3.25	.....	2.28	.....	1.27
May	1,416	1,646	.....	5.11	5.93	.....	11.18	.....	0.46
June	1,914	1,945	.....	6.67	6.79	.....	10.51	.....	0.63
July	2,324	2,257	.....	8.37	8.15	.....	15.99	.....	0.52
August	2,811	2,679	.....	10.14	9.65	.....	12.83	.....	0.79
September	2,529	2,384	.....	8.82	8.32	.....	12.05	.....	0.73
October	2,917	2,896	.....	10.51	10.44	.....	14.25	.....	0.74
November	3,744	3,389	.....	13.06	11.82	.....	18.90	.....	0.69
December	2,981	2,926	.....	10.75	10.55	.....	7.47	.....	1.44
Year	2,101	2,086	.....	89.51	88.87	.....	111.91	.....	.....

gives fictitious values exceeding unity, the monthly curves in the five basins are so nearly parallel that the grand mean given in Table 5, exhibiting the average variations from month to month, affords the best basis for a general discussion of this element. A curve representing the final mean has been added to fig. 6, with dots to show the corresponding values for the entire basin above Bohio, as given in Table 5. This curve, which is well worthy of study, demonstrates that the same conclusions result whether one or all five divisions of the valley are considered.

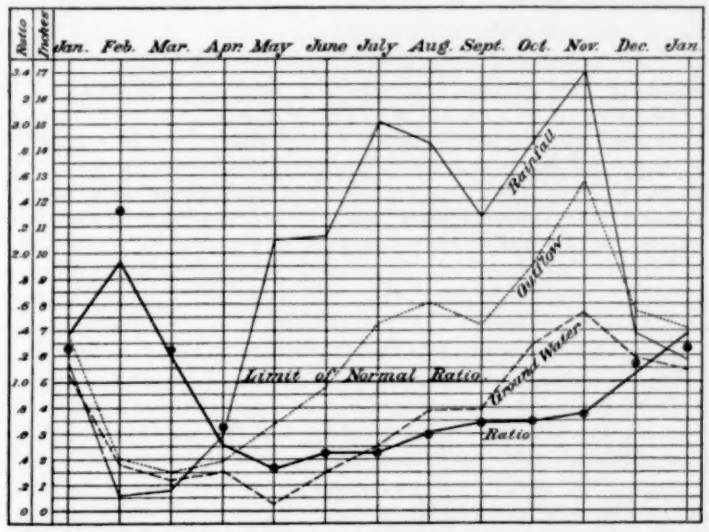

FIG. 6.—Hydrology of the basin of the Chagres River above Bohio. The three curves of mean monthly rainfall, outflow, and ground water are drawn to the scale of inches on the left-hand side, and accord with the data given in Table 7. The heavy curve, showing the ratio between the general average rainfall and drainage for the five basins for the six years is plotted according to the scale of ratios on the left-hand side, and accords with the general average given in Table 5.

Bearing in mind that the maximum normal value of the ratio is unity, corresponding to the hypothetical case that the entire rainfall of each month flows off during that month in the channel of the river, it is at once apparent that ground water plays a most important part in the regimen of the Chagres. The soil of the valley must act like a vast sponge and radically modify the rate of flow. In May, just after the end of the dry season, the ratio has its minimum value, about 0.3, the soil then being probably nearly or quite drained of its reserves. From this date the ratio continues gradually and steadily to increase, indicating a larger and larger volume of ground water escaping to the stream until, in November, when the outflow reaches its maximum, exceeding 12 inch-miles per month, the ratio becomes about 0.75. Then follows the dry season, when the rainfall soon becomes only about 1 inch-mile per month, but the ratio continues to rapidly increase to a maximum, in February, of about two units, indicating that the flow is then maintained almost wholly by ground water. From this maximum the ratio rapidly falls to the minimum, in May, by reason of the gradual failure of the ground-water supply. Incidentally, it may be remarked that nature thus provides an efficient and precious reserve to meet, in part, the needs of the canal. This matter is so important that it merits an analysis in figures.

The first step is to form an estimate as to what is the normal ratio between downfall and drainage when there is no flow of ground water. Table 5 presents 23 independent determinations of this ratio for the minimum month (May), giving an average value of 0.30, with a probable error of 0.03. As this value is not inconsistent with what investigations upon other streams of similar size and character of catchment basin would suggest, it will be adopted for the Chagres. While nothing is better established than that this ratio is subject to considerable variations, even in the same district, dependent upon whether the rainfall is gradual or comes in violent downpours

and upon other causes, it may be hoped that in this case observations have been continued for a period long enough to effect mutual cancelation among the variable elements to an extent sufficient to justify general conclusions from the following computations. Nothing more is claimed for them.

Upon the assumption then that in the Valley of the Chagres the normal value of the ratio between downfall and drainage, when there is no flow of ground water, is 0.30, the portion of each monthly outflow attributable to direct rainfall may be computed, since it is the product of the measured monthly outflow by the quotient obtained by dividing 0.30 by the observed value of the ratio for the corresponding month. The difference between such outflow and that directly measured will represent the volume attributable to ground water. The following table exhibits the results of such a computation applied to the mean outflow past Bohio during the six years recorded in Table 6. If 0.3 should be considered too small a value for the normal ratio when no ground water is flowing, it should be borne in mind that the only effect of an increase would be to reduce the estimated volume of the latter without effecting the essential fact that it constitutes a real and very important element in the regimen of the Chagres. For example, if the normal ratio be assumed as 0.5, which is probably excessive for this heavily wooded region, the computed volume of ground water in November, the maximum month, will only fall from 4800 cubic feet per second to 2666 cubic feet, and the corresponding volume of direct flow will only increase from 3200 cubic feet to 5334 cubic feet. Such a change has no important bearing upon the fundamental fact of the real flow.

TABLE 7.—*Means for six years in the basin above Bohio, 700 square miles.*

Month.	Rainfall.	Measured outflow.		Outflow due direct rainfall.		Outflow due ground water.	
		Foot-seconds.	Inch-miles.	Foot-seconds.	Inch-miles.	Foot-seconds.	Inch-miles.
	Inches.						
January	5.78	4,327	7.13	1,030	1.70	3,297	5.43
February	1.06	1,430	2.09	184	0.27	1,246	1.82
March	1.34	908	1.50	22	0.36	886	1.14
April	2.95	1,183	1.89	231	0.37	952	1.52
May	10.47	2,034	3.35	1,907	3.14	127	0.21
June	10.63	2,977	4.74	2,029	3.24	945	1.50
July	15.51	4,397	7.24	2,873	4.72	1,524	2.52
August	14.21	4,909	8.08	2,540	4.18	2,369	3.90
September	11.45	4,602	7.33	2,124	3.38	2,478	3.95
October	14.21	5,892	9.56	2,501	3.16	3,301	6.40
November	17.01	8,000	12.76	3,200	5.10	4,800	7.66
December	6.92	4,717	7.77	1,241	2.05	3,476	5.72
Year	111.54	3,774	73.44	1,657	31.67	2,117	41.77

On fig. 6 will be found a curve showing from month to month the volume attributed to ground flow as contained in Table 7. It is reasonable to suppose that the gradual and progressive filling and emptying of the subterranean reservoir, as rainy and dry seasons succeed each other, should cause a gradual progressive flow of ground water of like character, and this the curve certainly indicates. It may, therefore, be fairly claimed that it offers intrinsic evidence of its approximate accuracy. A comparison of dates shows that the rainfall during these six years attained its maximum in November and its minimum in February, and that the corresponding values of the ratio between downfall and drainage (Table 5) occurred respectively in February and May, or three months later in each case. Furthermore, the rate of increase of this ratio from month to month is less rapid at first than later, as would naturally be expected to result from the prolonged dry season during which the accumulated supply is slowly finding its way to the river bed. These facts perhaps suggest that the average rate of flow through the earth may be such as to require about three months to attain the river.

Finally the results of the analysis certainly demonstrate how groundless are the apprehensions that serious leakages may occur in the artificial lakes which form a part of the project. Manifestly, if important drains other than the bed of the river existed no such normal flow of ground water throughout the entire region is conceivable. The opinions of the geologists of the company are amply confirmed.

That a moderate percolation exists through the lower part of the tertiary deposit that fills the ancient gorge at and above Bohio is well known, and it is not without interest to consider what light this analysis throws upon its importance. Table 6 supplies the data. By regarding only the annual means, all complications resulting from ground water are eliminated, and as outflow per inch-mile and rainfall in inches are directly comparable conclusions may be formed from a simple inspection of the figures, which are here repeated for convenience of reference.

Locality.	Annual outflow, inch-miles.			Annual rainfall.	
	5 years.	6 years.	14 years.	5 years.	6 years.
Above Bohio	72.83	73.44	91.86	110.97	111.54
Above Gamboa	80.66	81.90	94.30	109.05	107.44
Lower subbasin	58.40	58.53	86.42	108.41	114.54
Middle subbasin	56.73	.....	.....	98.08	.....
Upper subbasin	89.51	.....	.....	111.91	.....

While it is to be regretted that the observations at Alhajuela were not begun sooner, this evidence is sufficient to justify the belief that the largest rainfall and the largest outflow per square mile occur in the upper subbasin which nearly approaches the Atlantic coast. In the middle subbasin they appear to be the least, as might be expected since it is the one most remote from this rainy coast. But the lower subbasin, although receiving about the same rainfall as the general average throughout the entire basin, and more than that above Gamboa, has a less outflow per square mile than either. The latter district is the better standard of comparison, since the deficiency of outflow in the lower subbasin affects the average for the entire basin, while the average above Gamboa is not thus reduced, and the slight excess there, in recorded rainfall, indicates that the normal outflow of the lower subbasin should be at least equal. But the 5-year column of the table indicates an annual deficiency in outflow of about 22 inch-miles; the 6-year column, one of about 23 inch-miles, and the 14-year column (for which there are no corresponding rainfall data) one of about 8 inch-miles. The area of the lower subbasin being 250 square miles, these figures respectively correspond to discharges per second of 413 cubic feet, 432 cubic feet, and 195 cubic feet, which appear to be attributable to percolation through the bed of gravel underlying the present bed of the river at Bohio. While admittedly of questionable numerical accuracy, these figures are not alarming. They correspond to percolations of 0.06 and 0.02 inch in twenty-four hours, and the International Commission of Engineers advisory to the New Panama Canal Company estimated 0.24 inch as the probable percolation from the artificial lakes. Still it must not be forgotten that the flow will be increased under the increased head due to the artificial lake, and in my judgment this new data confirms the belief that the level of Lake Bohio should not be raised to the height demanded by the single lake project, and that reserves for the low-water needs of the canal should be stored in an upper lake above Alhajuela, where they will certainly be secured against leakage.

It remains to consider the general problem of what becomes of the rain that falls on the catchment basin of the Chagres, or, in other words, to estimate the volume of the residue after allowance has been made for direct and ground-water flow. This residue is usually classed as evaporation, although it really represents not only evaporation, properly so called, but also water absorbed by plants, much of which is ultimately returned as vapor to the atmosphere, and that part of infiltrated water which penetrates deeply into the earth and is

there consumed in the chemical changes in progress. The data available are insufficient to render it possible to differentiate between these three kinds of loss.

Table 7 is in a form to facilitate this study, and from it are extracted most of the items in the following table, which represents the entire catchment basin above Bohio during the six years for which complete data are available. The residue found by subtracting direct flow and ground water from rainfall is denominated evaporation, which is classed as negative when the rainfall becomes less than the outflow, by reason of ground water.

TABLE 8.—*Disposition of rainfall in the Valley of the Chagres.*

Month.	Rainfall.	Outflow, in inch-miles.		Evaporation.	
		Direct.	Ground water.	Inch-miles.	Per cent of rainfall.
	Inches.				
January	5.78	1.70	5.43	Negative.	
February	1.06	0.27	1.82	Negative.	
March	1.34	0.36	1.14	Negative.	
April	2.95	0.37	1.52	1.06	36
May	10.47	3.14	0.21	7.12	68
June	10.63	3.24	1.50	5.89	55
July	15.51	4.72	2.52	8.27	53
August	14.21	4.18	3.90	6.13	43
September	11.45	3.38	3.95	4.12	36
October	14.21	3.16	6.40	4.65	36
November	17.01	5.10	7.66	4.25	25
December	6.92	2.05	5.72	Negative.	
Year	111.54	31.67	41.77	38.10	34

It is to be noted that the monthly estimates for evaporation in Table 8 are subject to the criticism that the ground-water flow due to rain falling in previous months is included in the computations for each month, and must vitiate the results. If the rate of flow through the ground were definitely known this error could be corrected, but this is a refinement too uncertain to be attempted. The steady decrease in the percentage column from month to month in the rainy season is doubtless due to this cause, and the value for June and July, when there is little ground water, is, say, about 55 per cent, which is probably quite closely the average for the entire rainy season. The average value for the year, 34 per cent of the rainfall, is not vitiated by ground water, as it represents a complete cycle, and its small figure is due to the absence of surface water to be evaporated in the dry season. The reduced humidity then observed confirms this view.

It would appear, therefore, from this study of the rainfall above Bohio, that the annual loss by evaporation (as above defined) averages 3.18 inch-miles per month, corresponding to a flow from the entire 700 square miles of 1995 cubic feet per second, to compare with 1657 cubic feet of direct flow and 2117 cubic feet of ground-water flow. In other words, of the entire rainfall about one-third disappears, another third flows off directly by the channel of the Chagres, and the remaining third, after a retardation of perhaps three months by its passage through the soil, ultimately reaches the bed of the river as ground water.

Furthermore, the 3.18 inches lost monthly by evaporation correspond to a daily loss of 0.11 inch; and as this applies to the general surface of the country, not to water surfaces directly exposed to the atmosphere, it is in good accord with the measurements above quoted made by the Isthmian Canal Commission in Nicaragua where the climatic conditions are quite similar. Such figures certainly show that the high humidity observed on the Isthmus is easily explained, notwithstanding the large capacity for moisture in air of such high temperature.

To enable a comparison to be made between these results and those noted in more temperate regions, advantage is taken of the summary for 12 American streams given in the able paper on the "Relation of rainfall to run-off," by George W. Rafter, which forms "Water supply and irrigation paper," No. 80, of the United States Geological Survey, 1903. The available data respecting these streams were not sufficient to permit a quantitative estimate of the ground-water flow, but Mr. Rafter in his general summary of the subject states the following conclusions, which are amply confirmed by the Chagres records: "When rainfall is below the mean for several months ground water may be expected to become continuously lower, with the result that the flow of streams will be less." And, "The ground water must be taken into account in order to understand all the peculiarities of flow. A very important effect of forests is in increasing the ground-water flow." The following table is abstracted from that on page 99 of Mr. Rafter's paper, the unit being inches per square mile of the basin. The figures for the Chagres are repeated for convenience of comparison.

TABLE 9.—*Average annual rainfall, outflow, and evaporation in the catchment basin.*

Streams.	Years observed.	Catchment area.	Rainfall.	Outflow.	Evaporation.
		Sq. miles.	*Inches.*	*Inches.*	*Inches.*
Muskigum River	8	5,828.0	39.7	13.1	26.6
Genessee River	9	1,070.0	40.3	14.2	26.1
Croton River	23	338.8	49.4	22.8	26.6
Lake Cochituate	38	18.9	47.1	20.3	26.8
Sudbury River	26	78.2	46.1	22.6	23.5
Mystic Lake	18	26.9	44.1	20.0	24.1
Neshaminy Creek	16	139.3	47.6	23.1	24.5
Perkiomen Creek	16	152.0	48.0	23.6	24.4
Tohickon Creek	15	102.2	50.1	28.4	21.7
Hudson River	14	4,500.0	44.2	23.3	20.9
Pequannock River	9	63.7	46.8	26.8	20.0
Connecticut River	11	10,234.0	43.0	22.0	21.0
Chagres above Bohio	6	700.0	111.5	73.4	38.1

In round numbers, therefore, it appears that the valley of this tropical river has about 2.5 times the rainfall, about 3.3 times the outflow, and about 1.5 times the evaporation characteristic of the northeastern portion of the United States, and that ground water probably plays a much more important part in the regimen of the stream.

Now that the Panama Canal is about to pass under the control of the United States it is proper to state that to the wise forethought of Monsieur Maurice Hutin, the Director General, and of Monsieur Louis Choron, the Director of Investigations and of Construction, is due the credit for the exceptionally complete system of observations which renders possible a close study of every element involved in the preparation of the final plans for the completion of the canal. Such data is of vital importance, and could only have been secured by long years of labor.

RECENT PAPERS BEARING ON METEOROLOGY.

Dr. W. F. R. PHILLIPS, Librarian, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

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Marriott, W. Some Account of the Meteorological Work of the late James Glaisher. Pp. 1–22.

—— Currents in the Arctic Ocean. P. 28.

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Gibbs, L. Evaporation from the Land. [Note.] Pp. 39–40.

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Bourhill, H. Curious Electrical Phenomena. Pp. 55–56.

—— Death by Lightning. [Question of legal responsibility.] P. 56.
Mill, H. R. and Lempfert, R. G. K. The Great Dust-Fall of February, 1903, and its Origin. Pp. 57–91.
—— Climatology of St. Helena. [Note.] P. 91.
—— Explosive Lightning. [Extract of log of steamship *Varna*.] P. 93.
Evans, J. W. Climate of Caupolican Bolivia. [Extract of article of J. W. Evans.] P. 93–94.
—— Rainfall at Jerusalem and Hebron. P. 94.
—— Bloxam's Smoothing Process. Pp. 94–95.

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—— Rainfall of Great Britain. Pp. 23539–40.

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Clayton, Henry Helm. The Study of Sunspot Cycles. P. 8.
—— Ben Nevis Observations and Weather Forecasts. [Extract from Report of the Committee on Meteorological Observations on Ben Nevis.] Pp. 11–13.
Smyth, John. Rainfall on the River Bann, County Down, at Banbridge and Lough Island Reavy Reservoir for 40 years from 1862 to 1901. Pp. 13–15.

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Bemmeln, W. van. The Diurnal Field of Magnetic Disturbance. Pp. 153–174.
Rotch, A. Lawrence. Atmospheric Electricity and Terrestrial Magnetism at the British Association for the Advancement of Science 1903. Pp. 175–178.

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—— Die Temperaturänderungen in auf-und absteigenden Luftmassen. Pp. 156–160.
—— Die tiefste Temperatur an der Erdoberfläche. P. 184.
—— Ein Föhnwind von ungeheurer Ausdehnung. Pp. 184–185.
—— Ein ungewöhnlich schwerer Orkan im Korallenmeere. Pp. 230–232.
Jäger, G. Ueber Hagelbildung. Pp. 232–235.
—— Die Witterungsverhältnisse auf Island und deren Beziehungen zu den gleichzeitigen Witterungsanomalien in Nordwesteuropa. Pp. 235–238.
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Nippoldt, A. Frank H. Bigelow, Eclipse Meteorology and allied problems. Pp. 143–144.

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—— A. de Quervain: Aufsteige von Ballons-sondes in Russland. Pp. 22–26.
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—— Zum Klima von Cayenne. Pp. 43–44.
Hann, J. Sirocco in Tunis. Pp. 44–45.
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SOLAR HALO OF FEBRUARY 4, 1904, AT MILWAUKEE, WIS.

By J. W. SCHAFFER, Observer, Weather Bureau, dated February 23, 1904.

This beautiful and interesting optical phenomenon was observed at Milwaukee, Wis., February 2, 1904. When first seen at 10:30 a. m., it appeared exceedingly well defined, and evidently had been visible for some time previous; it lasted with more or less distinctness till noon, then rapidly waned. The solar halo was of 22° radius, and was very distinct; upon the east, west, and north sides were mock suns of unusual brightness. Broad white bands of light extended from the sun to the several parhelia, and also to the southern side of the halo, radiating like the spokes of a wheel. A white band passed through the sun from the east to the west, and was projected around the entire heavens in a complete circumference about 45° from the horizon. At the extreme north point of this band a faint mock sun marked the intersection of some invisible halo. Twenty-two and one-half degrees on either side of this parhelion were two more of much greater brightness.

At the points where the white band left the solar halo, at either side, two tangential arcs appeared convex to the sun; one on the eastern contact with horns turned to the east; one on the western contact with horns turned to the west. A brilliant and highly colored arc, convex side to the sun, was tan-

gent to the solar halo at its upper point between the sun and the zenith and a mock sun appeared at the point of tangency. The most beautiful formation of all was directly in the zenith. This was a halo of 4° radius surrounding the zenith; the half circle toward the sun was composed of the most intense colors and tints which delicately shaded to the northern half and gradually merged into a bright semicircumference. The colors were distinct and brilliant, being more intense than those of the rainbow, and so dazzling that satisfactory inspection could only be made through smoked glasses. In the arrangement of colors the red was on the side toward the sun.

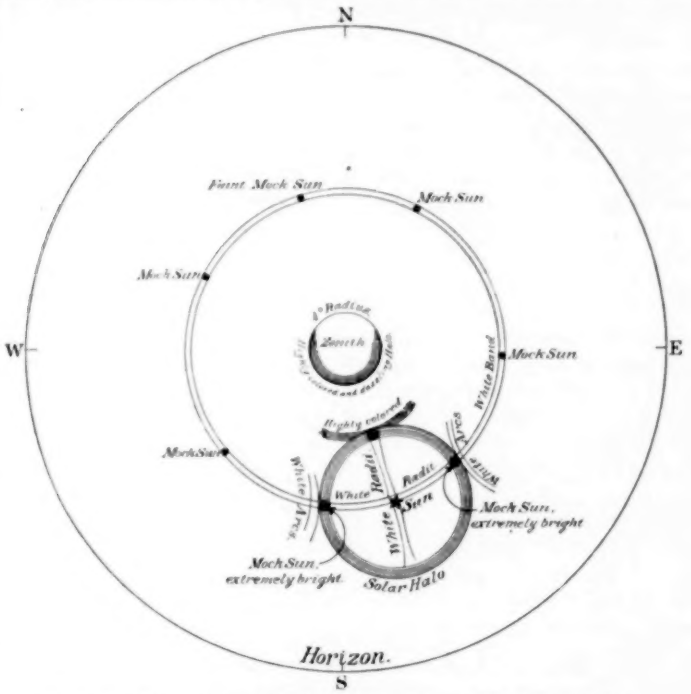


FIG. 1.—Solar halo at Milwaukee, Wis., February 2, 1904.

In a subsequent communication, Mr. Schaeffer adds the following items:

The sun rose February 2 at 7:13, sun time (latitude 43° 2′), and set at 5:13 p. m., making the sun ten hours above the horizon for the entire day. The solar halo was first observed at 9:10 a. m., and was judged to be the ordinary 22° halo. At 9:30 a. m. (or 10:30 a. m., seventy-fifth meridian time), the entire phenomenon was first observed, and continued with unabated distinctness until 12 noon, local time (ninetieth meridian time), then occupied about one-half hour in fading, becoming invisible at about 12:40 p. m. The zenithal halo waned slowly, or occupied about one-half hour, disappearing with the remainder of the phenomenon. The bright spots on either side of the extreme northern parhelion were judged to be about one-sixteenth of a circumference [or 22.5°] from the north point.

A BRIEF DISCUSSION OF CONDITIONS CONTRIBUTING TO FRESHETS IN THE JAMES RIVER WATERSHED.

By EDWARD A. EVANS, Section Director, Richmond, Va., dated July 10, 1903.

No one who has given serious thought to the subject of precipitation and resulting run-off can have failed to perceive that the relationship between them is a variable one; that practically equal quantities of rainfall over the same areas do not always produce equal or even approximately equal flood heights.

In considering the freshets of the James River watershed there are found to be always present certain conditions that affect the run-off. These conditions are divided into two groups, one of which may be designated as permanent, the other changing.

The permanent group comprises:
- Basin topography.
- Immediate stream environments.
- Soil structure.

The changing group consists of:
- Differences in air temperature and moisture.
- Differences in soil temperature and moisture.

The first group represents conditions, the value of which would always be fixed, definite, and unvarying with equal amounts of precipitation were it not for the operations of the factors contained in the second group. These, though permanent in the sense that they are always present, are termed "changing," because they vary constantly in the degree of their application, both with and in the seasons. They prevent a fixed ratio of run-off to precipitation, and for this reason assume a position of high importance in any consideration of questions relating to flood causation or control.

The purpose of this article is to present briefly some information bearing upon each of these groups.

BASIN TOPOGRAPHY.

Beginning with basin topography, a glance at the map of Virginia will show that that part of the James River watershed subject to overflow, and for which flood warnings are issued, fig. 1, extends from the Allegheny Mountains in the central-western portion of the State generally eastward to the head of tidewater at Richmond, a distance of about 263 miles. The greatest width of the watershed is approximately 80 miles, and the least about 5 miles. It consists of two distinct catchment basins which may conveniently be called the upper or mountain, and the lower or middle drainage areas.

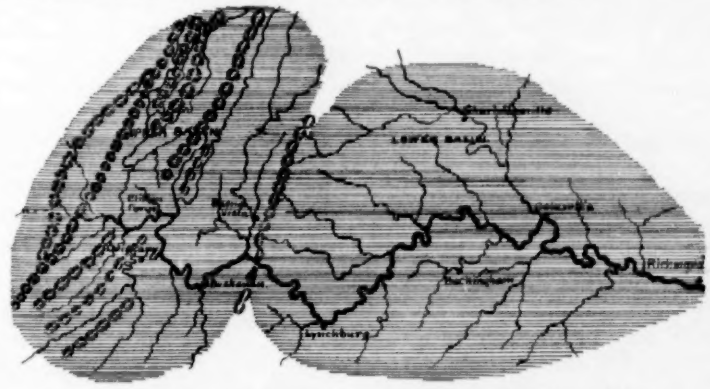


Fig. 1.—James River watershed—Covington to Richmond, Va.

Of these, the upper basin is an oval-shaped depression, the rim of which is composed of the Blue Ridge and the Allegheny mountains on the east and west, respectively, and high intervening uplift of valley lands on the north and south. Its trend is northeast and southwest along the line of its greatest diameter. It has an area of 2058 square miles, and its elevation above sea varies from 706 feet at Balcony Falls, where the James River breaks through the Blue Ridge on its way to the ocean, to about 4000 feet along the western crest of the watershed. In its western parts the surface is broken by numerous ranges of mountains, which lie parallel to the trend of the basin, and as they enter it gradually decrease in elevation until they merge into the high rolling lands of the Shenandoah Valley. These in turn sweep up to the Blue Ridge on the east. A network of branches, creeks, and rivers drain the Shenandoah Valley and the narrow valleys lying between the mountain ranges. Their combined waters enter the James River (which nearly equally bisects the upper basin) either from the northeast on its north side or from the southwest on its south side. These streams are all shallow, rocky, and swift flowing, falling rapidly from their headwaters to their point of junction with the main stream, and having many sinuosities.

The more important of these tributaries, with approximate figures of their greatest and least elevation above sea level, are given in the following table:

Principal tributary streams of the upper basin.

Tributary.	Elevation at source.	Elevation at mouth.
	Feet.	*Feet.*
Jackson	2,000	1,245
Cowpasture	2,000	980
Craigs Creek	1,400	960
North	1,300	730

The lower basin is of much the same outline as the upper basin, but in its surface characteristics it differs decidedly, being not nearly so rugged, except in its Blue Ridge portions. Its area is considerably greater, being about 4528 square miles, and its mean and extreme elevations are much less, while its greatest diameter bears east and west. Its boundaries are marked by the James-South Anna and the James-Chickahominy divides on the north side; by the James-Appomattox divide on the south; by the hill country on the edge of the marine plateau or coastal plain on the east; by the eastern face of the Blue Ridge on the west. Its maximum elevation, 2700 feet, occurs in the Rocky Row Mountains near Balcony Falls, while the minimum is zero, or mean tide at Richmond.

Seven principal tributary streams drain this basin, five of which originate in that part of the Blue Ridge which forms the northwestern boundary, and flow thence southeastwardly until their waters unite with the James River; the remaining two rise in isolated mountain spurs on the southwest edge of the basin, and flow to the northeast.

Approximate figures of greatest and least elevation above sea level for these tributaries follow:

Principal tributary streams of the lower basin.

Tributary.	Elevation at source.	Elevation at mouth.
	Feet.	*Feet.*
Pedlar	1,500	580
Tye	1,500	382
Rockfish	1,450	320
Slate	800	279
Rivanna	1,260	220
Willis	650	205
Hardware	1,000	285

A general survey of the watershed, fig. 1, discloses outlines that may be likened to a figure eight, placed on a horizontal plane with its left half flattened and its right half elongated. The crossing of the curves at the center would then indicate the water gap at Balcony Falls, where the two basins are united; the extreme right-hand end is at the falls of the James River at Richmond; the remaining curves would fairly correspond with the rim of hills and mountains that forms the crest of the divide between this and neighboring watersheds.

The diagram, fig. 5, gives the profiles separately of James River and James River watershed from Covington eastward to Richmond. Crossing the two basins on a nearly median line, and forming the backbone of the system of tributary streams, is the James River. In all its parts above tidewater this river is generally shallow. Especially is this true of its upper waters. Its bed is narrow, well-defined, and rocky, rising occasionally and forming boulder-strewn rapids of limited extent. Outcropping ledges of stratified rock cross it at frequent intervals until well into the lower basin, then disappear not to be seen again until within a few miles of Richmond when they again occur, forming rapids about 9 miles in length, having a fall of about 123 feet. The head of tidewater is at the foot of these rapids, which constitute what is known as the falls of the James River and furnish a magnificent and unfailing power. At the point where the rapids begin the river is first broken by large, isolated boulders. The number of these increases rapidly. Many of them attain the proportions of small rocky islets and have a dense growth of vines, underbrush, and small trees. Two rather large islands close the group, one, Belle Isle, lying about one-fourth of a mile above tidewater, and rising dome-like from the river bed to a height of 60 or 70 feet; the other, Mayos Island, low, flat, projecting into tidewater, and formed apparently by sedimentation upon the rocky shelf that crops out at this point. From Richmond eastward the river is navigable for sea-going vessels, is not seriously affected by freshet water, and therefore is not considered in this article.

STREAM ENVIRONMENT.

For the most part the immediate stream environment of the upper basin consists of precipitous slopes from mountain tops to valleys. This is especially true of those streams having their sources well up on the eastern flank of the Alleghenies, but, as the Shenandoah Valley is entered, the basin opens out to some extent and the slope of the surface of the land is not so sharp. However, in all cases it is steep enough to cause it to assume importance in its relation to floods by accelerating the rate of movement of the run-off resulting from precipitation.

In the Blue Ridge and Piedmont portions of the lower basin, stream environment does not differ greatly from that of the more rugged portions of the upper basin, the slopes from the crest of the mountains and hills to the river beds in the valleys being very sharp; but advancing eastward into the more open portions of the basin, the rolling character of the surface presents less abrupt descents and greater drainage areas for individual streams. The fall of the river beds also is less and the normal rate of water travel is diminished. In general the streams are deeper and the rocky bottoms and banks that mark the region of their source disappear. Four of the streams mentioned above, viz: Pedlar, Tye, Rockfish, and Slate, are true mountain streams, being swift flowing, rocky, and turbulent. The Hardware, Willis, and Rivanna rivers, throughout the greater portion of their course, pass through a relatively open country, drain more of the basin, and move less swiftly on their way to the main stream.

SOIL STRUCTURE.

The soil of the watershed varies decidedly in structure and in depth. With the exception of the humus it is derived, as is all soil, from rock, and is, therefore, coarse or fine in grain according to the character of the rock from which it came. Thus, in the case of coarsely crystalline rock, as some kinds of granite and limestone, the eroded particles are relatively large, and form a loose, sandy, porous soil, while fine grained rock, as argillite, will yield relatively small particles and form compact soils, as clay-loams and clay. Coarse granite and limestone, together with argillite, are commonly found in the mountainous portions of the James River watershed, and the local soils are derived therefrom, each kind occupying a situation appropriate to its origin.

The soils of the watershed are considered in fig. 2 with respect to their relative capacity for absorption of precipitation, as it is this aspect that determines their importance in assisting to produce flood water. In general, throughout the watershed, three characteristic types of soil structure are found; one of them is porous enough to be designated and considered as water absorbing, while another, by reason of its compactness, may be fitly termed water resisting.[1] It will be evident upon even cursory examination of the subject that these qualities must have an important bearing on the matter of run-off. Over areas where the soil is light, porous, and sandy, surface drainage must be nearly *nil* until a condition of saturation is reached, and as to this the quantity and rate of rainfall and the depth of soil would be the determining factors. On the other hand, where the soil is compact, dense, and fine grained, absorption would be so greatly re-

[1] The action of these soils in absorbing or shedding rainfall is referred to; not their capacity for holding a quantity of water.

duced that practically all rainfall in excess of that required to wet the surface would be realized as run-off. This is, of course, subject to such modifying conditions of soil and air temperature and moisture, and of wind movement as may obtain in any season.

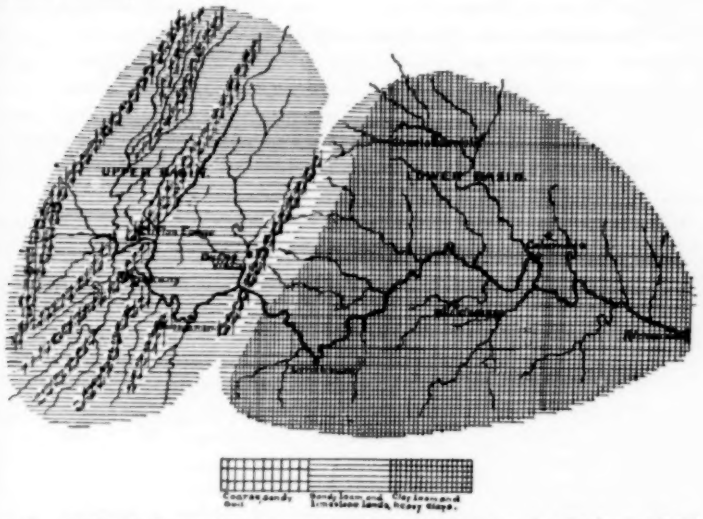


Fig. 2.—Soils of James River watershed—Covington to Richmond, Va.

The mountain soil of both the upper and lower basins of the watershed is loose, sandy, and shallow, forming nothing more than a thin covering for the rock of the region; it is spongy, permeable soil, receptive, but not retentive. In the small elevated valleys, the soil is similar, but deeper, in rather more compact form, and with a greater proportion of humus.

In the Shenandoah watershed of the upper basin the character of the soil changes to sandy loam and limestone lands. The soil particles are finer, and hence, in structural order, the soil is more compact than that of the mountains. It overlies rock, is relatively deeper compared with that of the mountains, and is more retentive, but not so receptive of water. Over the greater part of the lower basin clay-loams and dense, heavy clays obtain. Soils of these types, particularly the latter, are characterized by a great storage capacity for water if time be allowed for absorption, but they are so impermeable, so water-resisting, by reason of their density, that in ordinary cases of precipitation occurring as rain the amount absorbed would be trifling in comparison with that shed. This fact will be the first to attract attention when the cause of the greater frequency of freshets in the lower basin is considered.

The importance of the degree of compactness of the soil as governing the movement of surface and ground waters is generally mentioned by all authorities. Storer, in Agriculture, volume 1, p. 72, touching this, says: "In the case of clayey soils special regard must be had to the impermeable character of the clay." Again, on page 80, he mentions a test made by Gasparin of the rate of percolation through wet soils, in which "a layer of water 20 inches deep passed through a layer of soil 12 inches thick" in a specified number of hours. Quoting from this the tests of the soils nearest approaching those of the James River watershed, we have:

	Hours.
Coarse sand somewhat calcareous	1.54
Limestone soil with 11 per cent humus	7.94
Refractory clay from a field	168.00

The first of these soils would approximate the mountain soils, the second the Shenandoah Valley soils, and the third a large portion of the soil of the lower basin. While this test relates to a rate of percolation, it inversely shows what the proportion of surface drainage for soils would be. Let us suppose the conditions of the test to be changed so that the water, instead of being compelled to pass through the soil, is free to run off. How much of it in such a case would be absorbed by the refractory clay that required a period of a week, in the test, before percolation was complete?

On the other hand, in the coarse soil percolation was complete in less than two hours, that is to say, in one-eighty-fourth of the time required for the heavy clay. In the case of rain, the clay should, then, almost immediately begin to furnish run-off, while the sandy soils would accumulate water, except for seepage over shelving lands, until subsoil or rock was reached, when its action, as described by King, in Irrigation and Drainage, p. 330, would be to "* * * travel sideways by capillarity fastest * * * for the same reason that it flows downward fastest, namely, because the pores are largest and offer less resistance to the flow."

VARIATIONS IN TEMPERATURE AND MOISTURE OF AIR AND SOIL.

Every fall of temperature below the dew-point is accompanied necessarily by condensation, and every rise of temperature is accompanied necessarily by evaporation. It is the application of this law in nature that keeps water vapor constantly hesitating between the visible and invisible states.

When a given mass of air is increased in temperature by an access of heat, its capacity for water vapor increases. If a fall of temperature follows, the capacity is decreased, and, if the fall of temperature be sufficient, precipitation must occur.

In those latitudes where, during the winter months, the temperatures are ordinarily low, the capacity for moisture at that season must be considerably less than at other seasons. The winter season may, therefore, be considered as one in which the process of evaporation is being sluggishly carried on. Moreover, with the approach of winter the soil becomes chilled, and the evaporation of its moisture content is thus greatly retarded. Again, if the soil should become frozen, absorption would in great part cease. It seems reasonable, therefore, that these conditions can not help but greatly increase the percentage of run-off that may be had during the winter season in cases of precipitation occurring as rain.

On the other hand, during the summer, when the air is most warmed and its capacity for water vapor is greatest, and when the surface soil becomes hot and dry and precipitation is local and less frequent, the proportion of rain that is lost by evaporation and absorption becomes very great and the amount available to produce flood water is correspondingly diminished; so much so, indeed, that it may, and often does, happen that a fall of rain sufficient to cause a flood if it occurred in the winter, spring, or fall, fails to do so in summer under the conditions noted. Summer freshets, as compared with those occurring at other times of the year, are, therefore, infrequent and usually unimportant, but the rainfall producing them is generally much greater than that required to cause a flood rise in the fall, winter, and spring. The opinion seems popularly to prevail that the rarity of freshets in summer is due to the local nature of the precipitation. There can be no doubt that this fact has some bearing on the matter, but, as compared with the effects of evaporation and absorption, it is relatively unimportant. The quantity of water that may be taken up by even one of these processes is enormous. On page 88, Storer, in Agriculture, referring to this matter, says: "Stockbridge observed during seven growing months of the year that out of a total of 25.70 inches of rainfall, 20.56 inches evaporated," or about 84 per cent. The circumstances of this test were such as to make its application in the present instance hardly suitable, but it is mentioned as showing how important a factor in flood control evaporation may become.

If it were possible to have a uniform condition of temperature of the air and soil and a uniform condition of physical structure of the soil, in the watershed, there would seem to be no good reason why equal or nearly equal amounts of precipitation should not produce equal or nearly equal flood heights,

but such heights rarely result under prevailing conditions, and as we find constant changes in the temperature and moisture of the atmosphere and of the surface soil, as well as differences in soil structure, it seems that to them must be attributed the variable relationship between precipitation and run-off.

Turning to the record of precipitation that has produced floods in the James River watershed, and going as far back as reliable reports of one can be coordinated with the other, that is from 1895 to 1902, inclusive, it is found, first of all, that there is only one recorded instance of a summer freshet, that of July 10–11, 1896. The rains producing this rise averaged 3.40 inches for the watershed and the maximum river gage reading at Richmond during the flood condition consequent thereon was 12.5 feet. Comparing this with winter, spring, and fall freshets the record is as follows:

1895.—One rise each in January, March, and April, giving maximum stages of 18.2, 12.7, and 16.2 feet from an average precipitation for the watershed of 3.50, 1.14, and 1.92 inches, respectively.

1897.—Two February rises with maximum stages of 11.9 and 15.0 feet from an average precipitation of 1.76 and 2.01 inches, respectively.

1898.—One rise in October, reaching a maximum of 11.6 feet from an average precipitation of 2.47 inches.

1899.—One rise in January and two in March (February rise due to ice jam and omitted), reaching maximum stages of 13.5, 20.5, and 15.2 feet from an average precipitation of 1.31, 1.82, and 1.94 inches, respectively.

1901.—April and May each one rise, having maximum gage readings of 14.5 and 19.3 feet from an average precipitation of 2.25 and 2.40 inches, respectively, and two rises in December, giving maximum stages of 12.3 and 23.3 feet from an average precipitation of 2.25 and 3.40 inches, respectively.

1902.—One rise each in February and March, having maximum stages of 17.0 and 18.0 feet from an average precipitation 1.46 and 1.64 inches, respectively, and one rise in October of 12.0 feet, maximum, from an average precipitation of 4.45 inches.

The number of stations from which these data were compiled was about the same for each year, and the results have been put into tabular form.

Two prominent conditions appear therein:

1. A large percentage of run-off in the winter from relatively moderate amounts of rainfall.

2. A small percentage of run-off in summer from relatively large amounts of rainfall.

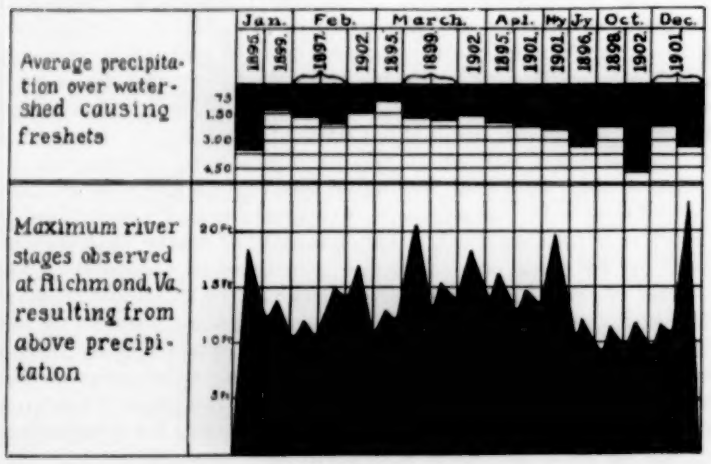


Fig. 3.—Precipitation and freshets resulting therefrom in James River watershed (1895 to 1902, inclusive).

A very instructive example of the difference between summer and winter run-off may be found in the freshets of July, 1896, and December, 1901. In each case the average precipitation for the watershed was 3.40 inches, but while in July the resulting run-off gave a maximum stage of 12.5 feet, in December it gave 23.3 feet, or very nearly double the quantity. On the other hand, some of the data appear inconsistent with this conclusion, as in the Octobers of 1898 and 1902, when large amounts of rainfall produced very moderate freshet stages. In these cases, however, the inconsistency is only apparent. It so happened that the monthly temperatures, especially in the watershed, were above normal (and in one case had been above normal for two months preceding), also that the precipitation for the preceding four months was quite considerably below normal. Under these circumstances the soil would have become more than normally warm and so thoroughly dried that both evaporation and absorption would have been greatly increased in their effects and the run-off correspondingly lessened. In the diagram referred to, fig. 3, precipitation causing floods for the years given and the maximum river stages resulting therefrom at Richmond, Va., have been coordinated.

Taken in connection with fig. 4, a very interesting example

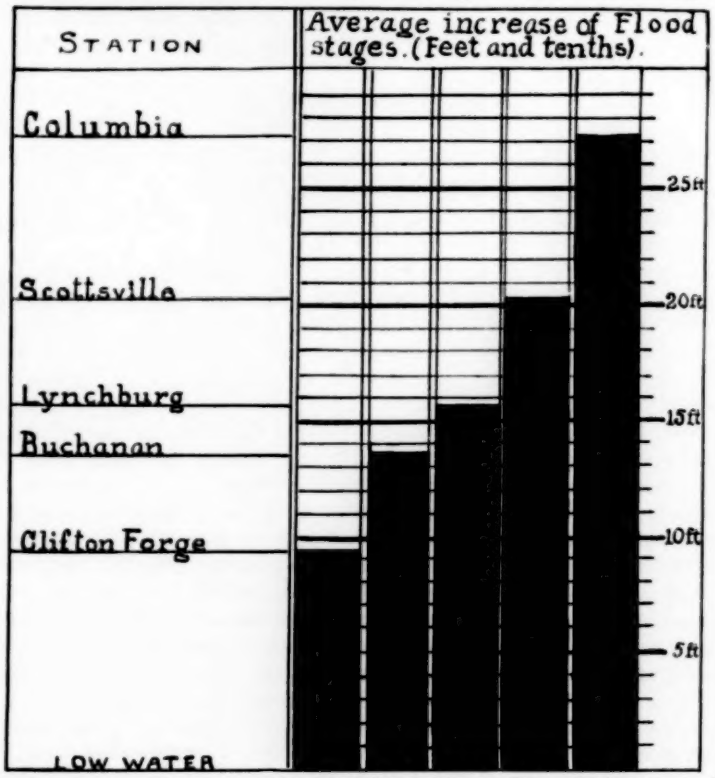


Fig. 4.—Average increase of flood heights in James River during general precipitation.

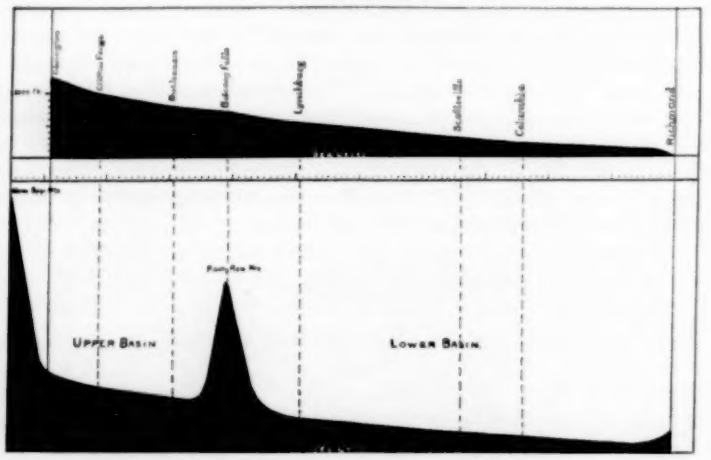


Fig. 5.—Profile of James River and James River watershed—Covington to Richmond, Va.

of the cumulative effect of rainfall is discovered. Assuming rainfall to be general over the watershed, each tributary in contributing its waters should serve to swell, by so much surplus as it carried, the total volume of the main stream, and this augmentation would, in turn, be shown by river gage readings made at or immediately below the point where it joined the main stream. Figuring on this basis and using maximum freshet data of from six to seventeen years, the average increase of freshet water carried by the James River would result, indicating what might be termed the discharge value of single or grouped tributaries. Thus, an average freshet height of 9.5 feet, representing the discharge of Dunlops Creek and Jackson River, is increased to 13.7 feet at Buchanan from the outflow of the Cowpasture River and Craigs and Catawba creeks; to 15.7 feet at Lynchburg from the waters of North River and smaller streams; to 18.9 feet at Scottsville by the Pedlar, Tye, and Rockfish rivers and smaller streams; and to 27.3 feet at Columbia by the State and Rivanna rivers. It is to be noted, however, that the local conditions at Columbia are such as to prevent a true increase or discharge value from being observed. The Rivanna River, the main tributary of the lower basin, here enters the James River at right angles, and the latter being narrow and shallow at this point becomes congested and a piled up condition of the water results that gives the local reading a value in excess of what it actually should be. Making allowance for this condition, it is probable that the ratio of increase at Columbia would be but slightly greater than that for Scottsville.

STUDIES ON THE CIRCULATION OF THE ATMOSPHERES OF THE SUN AND OF THE EARTH.

By Prof. FRANK H. BIGELOW.

IV.—VALUES OF CERTAIN METEOROLOGICAL QUANTITIES FOR THE SUN.

THE IMPORTANCE OF THESE VALUES TO TERRESTRIAL METEOROLOGY.

The most important data needed for use in studies in solar physics are the correct values of the pressure, the temperature, the density, the gas constant, and their many derived relations, at the surface of the sun, within its mass, and throughout the gaseous envelope. In the present uncertain state of our knowledge of these quantities, even an approximate derivation of these data is important, and this forms the justification for the studies contained in this paper. The problems of the circulation within the sun's photosphere, the transitions and the transformations in the atmospheric envelope with the attendant radiations and absorptions, the heat and light received at the outer surface of the earth's atmosphere, the resulting absorption and transmission of energy in the air, and the dependent circulation, are all languishing for the lack of a sound footing for our computations and deductions. The computations for the surface temperature of the sun give results ranging from 5000° to 10,000°; using Ritter's Law, Professor Schuster computes the temperature at the center of the sun as 12,000,000°, assuming that it is composed of hydrogen split up into monatomic elements. But it is evident that any such range of temperature would simply explode the sun, whereas it now circulates in a moderate manner. Unless some value for the temperature of the solar photosphere can be found, it will be impossible to determine what percentage of the total solar radiation is absorbed in the solar envelope, even though the radiant heat be computed successfully on the outer surface of the earth's atmosphere from radiation measurements at the ground. Should the following remarks prove to be merely suggestive it will be proper to make them as a contribution to the problems in solar physics.

I have been interested in the paper by Prof. F. E. Nipher, on the "Law of contraction of gaseous nebulæ,"[25] because it seems to offer a way of escape from the impossible results which follow from Ritter's equations, where the exponent in $P v^n = B$ is 1.33 +. Nipher makes the value of $n = 1.10$, and from this exponent the entire system of relations seems to be more probable. I will recapitulate Nipher's equations, after making the following changes in his notation to reduce them to the symbols used in my papers:

	Nipher.	Bigelow.
Gas constant	change	C to R
Density	"	δ " ρ
Distance from center	"	R " r
Mechanical equivalent of heat	"	J " $A' = \frac{1}{A}$
Heat equivalent of work	"	$\frac{1}{J}$ " $A = \frac{1}{A'}$
Constant	"	A " B
Ratio	"	ρ " b
Constant	"	k " k^2

NIPHER'S EQUATIONS.

Adiabatic law for perfect gases:

(41) $P v = R T.$

Heat relation:

(42) $dQ = c_v dT + P dv.$

Assumed laws for non-perfect gases:

(43) $P v^n = P_0 v_0^n = B.$

(44) $T v^{n-1} = \frac{B}{R}.$

(45) $\frac{T^n}{P^{n-1}} = \frac{B}{R^n}.$

Specific heat:

(46) $\left(\frac{dQ}{dT}\right)_n = c_v + \frac{AR}{1-n}$ $\qquad A = \frac{1}{4.19 \times 10^7}.$

Gravitation:

(47) $\frac{dP}{dr} = -k^3 \frac{M}{r^2} \rho = -k^2 \frac{M}{r^2} \left(\frac{P}{B}\right)^{\frac{1}{n}}$ $\qquad k^2 = \frac{1}{1.5173 \times 10^7}.$

Pressure:

(48) $P = \left[\frac{4n - 3n^2}{(2-n)^2} \cdot \frac{B^{\frac{2}{n}}}{2\pi k^2 r^2}\right]^{\frac{n}{2-n}} = \left[\frac{0.95 B^{1.82}}{2\pi k^2 r^2}\right]^{1.22}$

$= \frac{0.95 R^2 T^2}{2\pi k^2 r^2} = \frac{0.636}{8\pi} \frac{M^2 k^2}{r^4}.$

Density:

(49) $\rho = \left[\frac{4n - 3n^2}{(2-n)^2} \cdot \frac{B}{2\pi k^2 r^2}\right]^{\frac{1}{2-n}} = \left[\frac{0.95 B}{2\pi k^2 r^2}\right]^{1.11}$

$= 0.95 \frac{R T}{2\pi k^2 r^2} = \frac{0.78}{4\pi} \frac{M}{r^3}.$

Temperature:

(50) $T = \frac{B^{\frac{1}{2-n}}}{R} \left[\frac{4n - 3n^2}{(2-n)^2} \cdot \frac{1}{2\pi k^2 r^2}\right]^{\frac{n-1}{2-n}} = \frac{B^{1.11}}{R} \left(\frac{0.95}{2\pi k^2 r^2}\right)^{0.111}$

$= 0.818 \frac{M k^2}{2 R r}.$

Mass:

(51) $M = 4\pi \left(\frac{2-n}{4-3n}\right) \left[\frac{B(4n-3n^2)}{2\pi k^2 (2-n)^2}\right]^{\frac{1}{2-n}} r^{\frac{4-3n}{2-n}}$

$= 5.14\pi \left(\frac{0.95 B}{2\pi k^2}\right)^{1.11} r^{0.77}$

$= \frac{n}{2-n} \cdot \frac{2r R T}{k^2} = 1.22 \frac{2R T r}{k^2}.$

[25] Transactions Academy of Science, St. Louis, October 1, 1903.

Weight of one gram at the surface:

$$(52)\quad g=\frac{k^2 M}{r^2}=4\pi k^2\left(\frac{2-n}{4-3n}\right)\left[\frac{B(4n-3n^2)}{2\pi k^2(2-n)^2}\right]^{\frac{1}{2-n}}\frac{1}{r^{\frac{n}{2-n}}}$$

$$=5.14\pi k^2\left(\frac{0.95B}{2\pi k^2}\right)^{1.11} r^{\frac{1}{1.22}}$$

$$=\frac{n}{2-n}\cdot\frac{2R\,T}{r}=1.22\frac{2R\,T}{r}.$$

Auxiliaries:

$$(53)\quad B=P v^n=\frac{k^2}{2n}\left(\frac{4\pi}{4-3n}\right)^{\frac{1}{3}}(2-n)^{\frac{4}{3}} M^{\frac{2}{3}}$$

$$=\left[\frac{2\pi k^2}{(4-3n)n}\right]^{\frac{1}{3}}\left[(2-n)R\,T\,r\right]^{\frac{2}{3}}.$$

$$(54)\quad B'=\left[\frac{(4n-3n^2)B}{(2-n)^2 2\pi k^2}\right]^{\frac{1}{2-n}}.$$

Contraction ratio $b=\frac{r_0\ \text{(initial)}}{r\ \text{(final)}}$:

$$(55)\quad P=P_0\left(\frac{r_0}{r}\right)^4=P_0 b^4$$

$$(56)\quad \rho=\rho_0\left(\frac{r_0}{r}\right)^3=\rho_0 b^3$$

$$(57)\quad T=T_0\left(\frac{r}{r_0}\right)=T_0 b^{-1}.$$

Mass:

$$(58)\quad M=\frac{4}{3}\pi r^3\cdot\rho_a=4\pi\frac{2-n}{4-3n}\rho\cdot r^3.$$

Average density:

$$(59)\quad \rho_a=3\frac{2-n}{4-3n}\frac{B'}{r^{\frac{2}{2-n}}}=3\frac{2-n}{4-3n}\rho=\ldots\ldots\ldots\ldots 3.86\,\rho$$

Distance from center to stratum where the density ρ = average density ρ_a:

$$(60)\quad r_a=\left[\frac{4-3n}{3(2-n)}\right]^{\frac{2-n}{2}} r=\ldots\ldots\ldots\ldots\ldots\ldots 0.545\,r$$

Average pressure:

$$(61)\quad P_a=\frac{4\pi\int_0^r r^2 P\,dr}{4\pi\int_0^r r^2\,dr}=3\frac{2-n}{6-5n}P=\ldots\ldots\ldots\ldots 5.40\,P$$

Distance from center to stratum where the pressure P = average pressure P_a:

$$(62)\quad r_a=\left[\frac{1}{3}\cdot\frac{6-5n}{2-n}\right]^{\frac{2-n}{2n}} r=\ldots\ldots\ldots\ldots\ldots\ldots 0.502\,r$$

Average temperature:

$$(63)\quad T_a=3\cdot\frac{2-n}{8-5n}\,T=\ldots\ldots\ldots\ldots\ldots\ldots 1.08\,T$$

Distance from center to stratum where the temperature T = average temperature T_a:

$$(64)\quad r_a=\left[\frac{1}{3}\cdot\frac{8-5n}{2-n}\right]^{\frac{2-n}{2(n-1)}} r=\ldots\ldots\ldots\ldots\ldots\ldots 0.707\,r$$

Specific heat:

$$(65)\quad \frac{dQ}{dT}=\frac{c_v\frac{dP}{P}+c_p\frac{dv}{v}}{\frac{dP}{P}+\frac{dv}{v}}=\frac{c_p-n\,c_v}{1-n}=\frac{c_p}{\kappa}\left(\frac{\kappa-n}{1-n}\right).$$

Auxiliaries.

$$(66)\quad \left(\frac{dQ}{dT}\right)_n=c_p-A\,T\left(\frac{dv}{dT}\right)_p\left(\frac{dP}{dT}\right)_n \qquad \frac{dP}{P}=-n\frac{dv}{v}.$$

$$=c_p-A\,T\frac{R\,M}{P}\cdot\frac{R\,M}{v} \qquad v^n dP=-n\,P\,v^{n-1}dv.$$

$$=c_p-A\,R\,M^2 \qquad \frac{dP}{P}=-\frac{2n}{2-n}\frac{dr}{r}.$$

$$=c_p+4A\,R \qquad \frac{dv}{v}=+\frac{2}{2-n}\frac{dr}{r}.$$

$$=c_v+\frac{A\,R}{1-n}=-7.365\ \text{(reversing sign)}.$$

$$(67)\quad n=\frac{2c_p+4A\,R}{2c_p+3A\,R}=\frac{6\kappa-4}{5\kappa-3}=1.10.$$

$$(68)\quad c_p=A\,R\frac{3n-4}{2-2n}=A\,R\frac{\kappa}{\kappa-1}=A\,R\frac{4-3c}{2c-1}.$$

$$(69)\quad R\,T=P\,v=\frac{4}{3}\pi r^3 P=\frac{2-n}{n}\cdot\frac{M k^2}{2r}=0.818\frac{M k^2}{2r}.$$

Heat:

$$(70)\quad Q=\left(\frac{dQ}{dT}\right)_n(T-T_0)=-(c_p+4A\,R)(T-T_0)$$

$$=-(c_p+4A\,R)\,T_0(b-1).$$

Work:

$$(71)\quad W=\int P\,dv=P_0 v_0^n\int_{v_0}^{v}\frac{dv}{v^n}=\frac{P_0 v_0}{1-n}(b-1),$$

$$=\frac{A\,R\,T_0}{1-n}(b-1)=-(c_v+c_p+4A\,R)T_0(b-1),$$

$$=4\pi\int_r^\infty r^2 P\,dr=\frac{4-3n}{n}\frac{M^2 k^2}{2r}=0.636\frac{M^2 k^2}{2r}.$$

Ratios:

$$(72)\quad c=\frac{Q}{W}=\frac{c_p+4A\,R}{c_v+c_p+4A\,R}=\frac{c_p+4A\,R}{2c_p+3A\,R}=\frac{5\kappa-4}{5\kappa-3}=0.75.$$

$$(73)\quad \frac{Q}{W-Q}=\frac{c_p+4A\,R}{c_p-A\,R}=\frac{c_p+4A\,R}{c_v}=\ldots\ldots 3.00.$$

$$(74)\quad \frac{W}{W-Q}=5\kappa-3=\ldots\ldots\ldots\ldots\ldots\ldots 4.00.$$

Differences:

$$(75)\quad c_p-c_v=\frac{8-5n}{3(2-n)^2}\cdot\frac{4-3n}{5\kappa-3}\cdot A\,R=\ldots\ldots 0.180A\,R$$

$$=\frac{1}{5\kappa-3}\cdot\frac{4-3n}{n}\cdot\frac{M k^2}{2r}\frac{A}{T_a}.$$

For a rise of 1° C., energy equivalent to $2c_p+3A\,R$ heat units must be applied to the unit mass, of which $c_p+4A\,R$ heat units are radiated per unit time, and $c_p-A\,R=c_v$ heat units are used in raising the temperature.

THE ASTRONOMICAL CONSTANTS FOR THE EARTH AND THE SUN.

It is difficult to select from the available astronomical data a system of constants that is rigorously self-consistent, and in this preliminary discussion it is not necessary to make complete adjustments between the several quantities. The fundamental units employed are conveniently the C. G. S. system, and not the C. S. system, because in the thermodynamic formulæ the unit of mass is the gram. In the C. G. S. system the gravitation constant is found from the formula,

$$(76)\quad g_0=k^2\frac{M_1 m}{R_1^2},\ \text{so that,}\ k^2=\frac{R_1^2 g_0}{M_1 m}.$$

The constant for transformations from the C. S. system to the C. G. S. system is $\frac{1}{k^2}$; i. e., (mass C. S.) $\frac{1}{k^2}$ = (mass C. G. S.).

TABLE 7.—*Astronomical constants.*

	Numbers.	Logarithms.
R_1 = mean radius of earth, *Bessel's* spheroid	6370 19100 cm.	8.8041525
R_1^2 =		17.6083050
R_1^3 =		26.4124575
ρ_{a1} = average density of earth, *Harkness*	5.576	0.746323
$\frac{4}{3}\pi$ =	4.1888	0.622089
$M_1 = \frac{4}{3}\pi R_1^3 \rho_{a1}$ = mass of the earth in grams	6.0377 × 180[27]	27.78070
m = 1 gram	1.00	0.000000
g_0 = acceleration per second at surface of earth	980.60 cm.	2.991492
$k^2 = \frac{R_1^2 g_0}{M_1 m}$ = constant	$\frac{1}{1.5173 \times 10^7}$	2.818927—10
$\frac{1}{k^2}$ = transformation constant	1.5173 × 10[7]	7.181073
$\frac{M}{M_1}$ = ratio of mass of sun to mass of earth, *Newcomb*	333432.	5.523008
M = mass of the sun	2.0132 × 10[33]	33.303878
r = radius of sun for *Auwer's* diameter (31′ 59.26″)	694800 80000 cm.	10.8418603
r^2 =		21.6837206
r^3 =		32.5255809
p = parallax of the sun, *Newcomb.*	8.7965″	0.9443099
D = distance from sun to earth	1493 40870 00000 cm.	13.1741786
r/R_1 = ratio of radii	109.071	2.0377078
S/S_1 = ratio of surfaces $(109.071)^2$	11896.4	4.0754156
V/V_1 = ratio of volumes $(109.071)^3$	1297548.	6.1131234
G = gravity at surface of sun / gravity at surface of earth $= \frac{M}{M_1} \cdot \frac{R_1^2}{r^2}$	28.028	1.4475924
ρ_s = mean density of the sun $= \frac{M}{M_1} \cdot \frac{R_1^3}{r^3} \cdot \rho_{a1}$	1.43287	0.156208
v = velocity of the earth in its orbit	18.5212 miles/sec.	1.267670
	29.80670 cm./sec.	6.474314
$f = \frac{v^2}{D}$ = acceleration at the distance of earth.	0.59491 cm./sec.	9.774448—10
	0.23422 inch/sec.	9.369615—10
$f = \frac{M}{M_1}\left(\frac{R_1}{D}\right)^2 g_0$ (check)		9.77448—10
$s = \frac{1}{2} f$ = rate at which earth falls toward sun.	0.29746 cm./sec.	9.473418—10
	0.11711 inch/sec.	9.068585—10

APPLICATION OF THE THERMODYNAMIC FORMULÆ TO THE GASEOUS ENVELOPE OF THE SUN.

The evidence from the action of the lines in the solar spectrum, as regards shifting, broadening, and reversals, shows that in the envelope resting upon the photosphere, comprising in its contents the reversing layer, the chromosphere, and the inner corona, the gases may be treated as approximately perfect gases and tending to conform to the Boyle-(Mariotte)-Gay Lussac law, $P v = \frac{K}{m} T$, where P is the pressure in units of force, v the volume, K the absolute gas constant, m the molecular weight, and T the absolute temperature. I propose, also, to apply the same law to the solar mass within the photosphere, with a suitable modification, and to compare the results with the data obtained from the use of Professor Nipher's equations. We can first multiply the equation by any numerical value, x, and distribute the variation between P and T alone, holding the density identical in the two conditions.

Hence,

$$(77) \qquad (x\,P)\,v = \frac{K}{m}(x\,T).$$

This asserts that if $\frac{K}{m}$ remains constant, $v = \frac{1}{\rho}$ also remains constant. If a gas, as hydrogen, $\rho = 0.000089996$, is subjected to the same relative increase in P and T, it remains at the same density as that for which its gas constant $\frac{K}{m}$ was computed.

We can, therefore, transform hydrogen, or other perfect gases, from terrestrial to solar conditions by simply multiplying by the proper factor. In this case it will be $x = 28.028$, the ratio of g at the surface of the sun to g_0 at the surface of the earth.

In Eclipse Meteorology and Allied Problems, chapter 4, Table 14.—"Fundamental constants," a series of values was computed depending upon assumed values of R, the sun's radius, and G, the ratio between gravity at the surface of of the sun and gravity at the surface of the earth. Since these values have been changed a little in the preceding computations, it will be necessary to reconstruct the numerical values of that table, although the effect upon the dependent quantities is not important. In order that the transition from terrestrial to solar conditions may be made as plain as possible to the reader, we will compute the fundamental constants on the supposition that the earth is surrounded by a hydrogen atmosphere instead of the common air, making allowance for the change in density.

TABLE 8.—*Constants for one atmosphere of hydrogen on the earth.*
$p_0 v_0 = R T_0 = l.$

Formulæ.	M. K. S. system.		C. G. S. system.	
	Numbers.	*Logarithms.*	*Numbers.*	*Logarithms.*
g_0 = gravity	9.806 m.	0.99149	980.6 cm.	2.99149
ρ_m = density of mercury	13595.8	4.13340	13.5958	1.13340
B_n = merc. col. for 1 atmos	0.760	9.88081	76.0	1.88081
ρ_h = density of hydrogen	0.089996	8.95422	0.000089996	5.95422
$p_0 = \rho_m B_n = \rho_h l$ (weight)	10333.	4.01421	1033.3	3.01421
$l = \frac{\rho_m B_n}{\rho_h}$ (hom. atmos)	114815.	5.05999	11481500.	7.05999
T_0 = temperature	273.	2.43616	273.	2.43616
$R_0 = \frac{l}{T_0}$ = gas constant	420.56	2.62383	42056.	4.62383
$v_0 = \frac{1}{\rho_h}$ = specific volume	11.112	1.04578	11112.	4.04578
$p_0 v_0 = l$	114815.	5.05999	11481500.	7.05999
$R_0 T_0 = l$	114815.	5.05999	11481500.	7.05999

TABLE 9.—*Transition to constants for a solar hydrogen atmosphere.*
$(G\,p_0)\,v_0 = R\,(T_0\,G).$

Formulæ.	M. K. S. system.		C. G. S. system.	
	Numbers.	*Logarithms.*	*Numbers.*	*Logarithms.*
$G = g/g_0$	28.028	1.44759	28.028	1.44759
$G\,p_0 = p$ (weight)	289600.	5.46180	28960.	4.46180
$v_0 = v$ (same density)	11.112	1.04578	111112.	4.04578
$p\,v = l$	3218000.	6.50758	321800000.	8.50758
$G\,T_0 = T$	7651.6	3.88375	7651.6	3.88375
$R_0 = R$	420.56	2.62383	42056.	4.62383
$RT = l$	3218000.	6.50758	321800000.	8.50758

TABLE 10.—*Fundamental constants for a hydrogen atmosphere on the sun.*

Data.	Formulæ.	Meter-kilogram-second.		Centimeter-gram-second.	
		Number.	Logarithm.	Number.	Logarithm.
Radius of the sun	r	694800800 m	8.8418603	694800 80000 cm	10.8418603
Gravity acceleration at the surface	$g = G\,g_0 = 28.028 \times 9.806$	274.843	2.4390843	27484.3	4.4390843
Modulus of common logarithms	M	0.4342945	9.6377843—10	0.4342945	9.6377843—10
Density: Mercury	ρ_m	13595.8	4.1334048	13.5958	1.1334048
Density: Water	ρ_l	1000	3.0000000	1.0000	1.0000000
Density: Air	ρ_0	1.29305	0.1116153	0.00129305	7.1116153—10
Density: Hydrogen	ρ_h	0.089996	8.9542232—10	0.000089996	5.9542232—10
Height of standard barometer	$B_0 = \frac{p}{\rho_m} = 0.760 \times 28.028$	21.3013	1.3284060	2130.13	3.3284060
Height of homogeneous atmosphere	$l = \frac{\rho_m B_0}{\rho_h} = R\,T = p\,v_h = \frac{p}{\rho_h}$	3218012	6.5075876	321801200	8.5075876
Barometric constant	$K = \frac{l}{M} = \frac{\rho_m B_0}{\rho_h M} = \frac{R\,T}{M}$	7409746	6.8698033	740974600	8.8698033
Pressure in units of weight	$p = \rho_h\,l = \rho_m\,B_0 = \frac{P}{g}$	289608.1	5.4618108	28960.81	4.4618108
Pressure in units of force	$P = \left\{ \begin{array}{l} g\,\rho_h\,l = g\,\rho_m\,B_0 = g\,p = P_0\,G^2 = \\ g\,\rho_h\,p\,v_h = g\,\rho_h\,R\,T = \frac{\kappa}{\kappa-1}\frac{l}{T} = \frac{C_p}{A} \end{array} \right\}$	79596670.9	7.9008951	795966709	8.9008951
Press. of one terrestrial atmosphere	P_0	101323.5	5.0057103	1013235 dynes	6.0057103
Volume (specific) of hydrogen	$v_h = \frac{1}{\rho_h}$	11.1116	1.0457768	11111.6	4.0457768
Gas constant for pressure p	$R = \frac{p\,v_h}{T} = \frac{\rho_m B_0}{\rho_h T}$	420.565	2.6238330	42056.5	4.6238330
Gas constant for pressure P	$Rg = \frac{P v_h}{T}\,g = \frac{\rho_m B_0}{\rho_h T}\,g$	1.15589×10^6	5.0629173	1.15589×10^9	9.0629173
Temperature at the photosphere	$T = 28.028 \times 273$	7651.6° C.	3.8837546	7651.6° C.	3.8837546
Temperature gradient	$-\frac{dT}{dh} = \frac{A}{c_p} = \frac{1}{P}$	1.2563×10^{-3}	2.0991049—10	1.2563×10^{-9}	1.0991049—10
Specific heat at constant pressure	$c_p = g\,\rho_h\,A\,R\,T$	186503	5.2706707	18.9968	1.2791478
Heat equivalent of work	$A = \frac{1}{426.8}$ and $\frac{1}{4.1855 \times 10^7}$	0.00234302	7.3697756—10	2.38663×10^{-8}	2.3782527—10
Coefficient from specific heats	$c_p = \frac{\kappa}{\kappa-1} = g\,\rho_h\,T$	189261.5	5.2770621	18926.15	4.2770621
Ratio of the specific heats	$\kappa = \frac{c_p}{c_v}$	1.000005	0.0000021	1.000052	0.0000228

The constants are worked out for the meter-kilogram-second (M. K. S.) system and for the centimeter-gram-second (C. G. S.) system, respectively, the formulæ, which are well known, being found in Table 64 of the Report of the Chief of the Weather Bureau, 1898–99, Vol. II.

If hydrogen, as a perfect gas, conforms to the Boyle-Gay Lussac law at so high a temperature as 7651.6, then there must be some stratum in the sun's atmosphere where the density is the same as it is under the standard conditions on the earth. If the gas ceases to be perfect to some extent, this statement must be proportionately modified, but in any case even approximate conditions will be very valuable as giving a general view of the prevailing state of solar physics, in which a footing of some sort is a desideratum for meteorology in general. We next determine the temperature gradient by the computation in Table 10, in which the same constants are employed as above, except that their values have been determined with greater precision.

To obtain the temperature gradient per meter, or the adiabatic rate of fall of temperature per meter, the value of $-\frac{dT}{dh}$ in the M. K. S. system must be multiplied by 1000, and in the C. G. S. system it must be multiplied by 10000 so that they both give

(78) $-\frac{dT}{dh} = 0.000012563°$ C. per meter, or,

(79) $-\frac{dT}{dh} = 0.012563°$ C. per 1000 meters.

This can be checked from the terrestrial adiabatic rate, which is 9.86938 per 1000 meters, by multiplying by $\frac{1}{G^2}$.

(80) Thus, $\left(-\frac{dT}{dh}\right)_{sun} = \left(-\frac{dT}{dh}\right)_{earth} \times \frac{1}{G^2}$.

(81) $0.012563 = 9.86938 \times \frac{1}{(28.028)^2}$.

The rate of the fall in temperature in the atmosphere of the sun is very slow according to this computation, so that variation in the density of the gases is not due so much to changes in temperature as to changes in pressure, which are very rapid, as is shown in Table 11 and fig. 21. The approximate formula

is all that is necessary in this discussion because of the steady state of the temperature just indicated.

Let P_0 = the pressure of 28.028 atmospheres, where h_0, the height, is assumed to be zero.
P = the pressure in atmospheres at the height h.
K = 7409.746 kilometers, the barometric constant.
Then we shall have the reduction formula:

(82) $\log \frac{P_0}{P} = \frac{h - h_0}{K}$, and $\log P = \log P_0 - \frac{h}{K}$.

The value of h in seconds of arc is found from

(83) $1''$ (second of arc) $= \frac{\text{radius of sun in kilometers}}{\text{radius of sun in seconds of arc}}$

$= \frac{694800.800}{16' \times 60 = 960''} = 723.751$ km.

DISTRIBUTION OF THE PRESSURE, TEMPERATURE, AND DENSITY IN A SOLAR HYDROGEN ATMOSPHERE.

Since in a perfect gas $Pv = \frac{P}{\rho} = RT$, we shall have for the density, $\rho = \frac{P}{RT}$. In order to compute R, the gas constant, we take $R = \frac{P}{\rho T}$, where,

$P = 28.028$ atmospheres,
$\rho = 0.089996$,
$T = 7651.6°$, whence we obtain
$R = 0.040702$ [logarithm = 8.6096146].

The values resulting from the computation are given in Table 11 and fig. 21, "Distribution of the pressure, temperature, and density in a solar hydrogen atmosphere." The indications regarding the prevailing pressure, derived from the behavior of certain lines in the solar spectrum, are that the reversing layer is under a pressure of about 5 atmospheres, or possibly as little as 3 atmospheres (Astrophysics, February, 1896, p. 139; May, 1898, p. 327; April, 1900, p. 240). According to Table 11 the pressure at the height 8″ above the stratum having a pressure of 28.028 atmospheres is 4.636, and this may be adopted as the height of the reversing layer. If the top of the photosphere is 1″ below the reversing layer, the top of the chromosphere 5″ above it, and the top of the inner corona 35″ above the top of the photosphere, then the layer at pressure 28.028 atmospheres is 7″ below the top of the photosphere, and is probably in the midst of the photospheric shell. The temperature gradient is a straight line,[26] but the pressure and density are distributed on curves of the logarithmic type. From 28 to 5 atmospheres the pressure and density change very *rapidly*, but from 2 to 0 atmospheres they change very *slowly*. There is a quick transition in the rate of change

TABLE 11.—*Distribution of the pressure, temperature, and density in the solar hydrogen atmosphere.*

h'' in arc.	h in km.	$\frac{h}{K}$	P	T	ρ	Height of layer $(h-7)''$ above photosphere.	
..						..	
45	32568.75	4.39539	0.001	7242.4	0.000004	38	Top of inner corona.
40	28950.00	3.90702	0.003	7287.9	0.000012	33	
35	25331.25	3.41864	0.011	7333.4	0.000036	28	
30	21712.50	2.93026	0.033	7378.8	0.000110	23	
25	18093.75	2.44189	0.101	7424.3	0.000335	18	
20	14475.00	1.95351	0.312	7469.7	0.001026	13	
18	13027.50	1.75816	0.489	7487.9	0.001605	11	
16	11580.00	1.56281	0.767	7506.1	0.002510	9	
14	10132.50	1.36746	1.203	7524.3	0.003927	7	Top of chromosphere.
12	8685.00	1.17210	1.886	7542.5	0.006143	5	
10	7237.50	0.97676	2.957	7560.7	0.009609	3	
9	6513.75	0.87908	3.703	7569.8	0.012018	2	
8	5790.00	0.78140	4.636	7578.9	0.015031	1	Reversing layer.
7	5066.25	0.68380	5.805	7587.9	0.018796	0	Top of photosphere.
6	4342.50	0.58605	7.270	7597.0	0.023512	—1	
5	3618.75	0.48838	9.104	7606.1	0.029406	—2	
4	2895.00	0.39070	11.400	7615.2	0.036779	—3	
3	2171.25	0.29303	14.275	7624.3	0.045999	—4	
2	1447.50	0.19535	17.875	7633.4	0.057532	—5	
1	723.75	0.09768	22.383	7642.5	0.071955	—6	
0	0	0	28.028	7651.6	0.089998	—7	Within the photosphere.

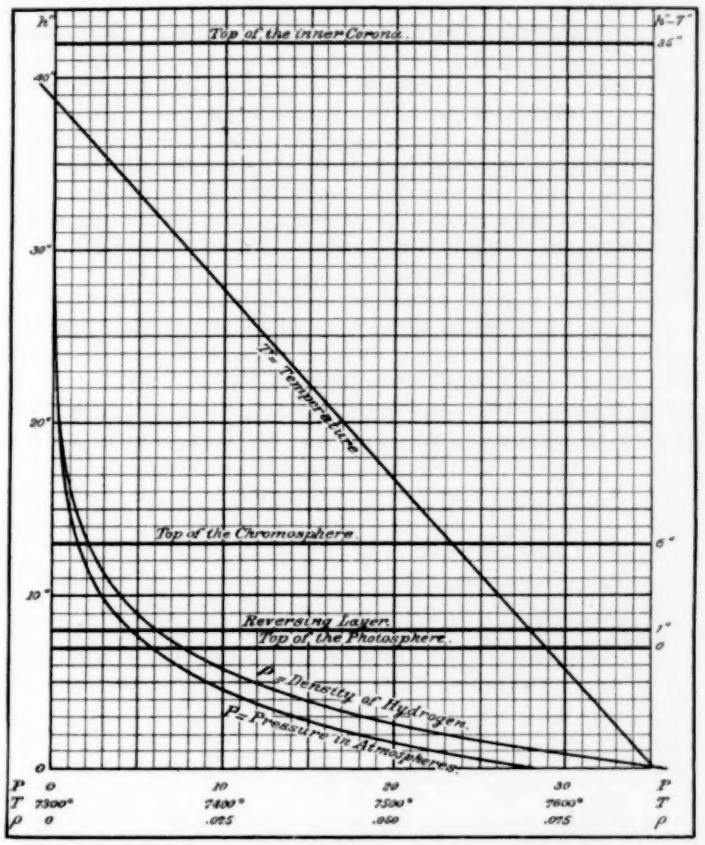


FIG. 21.—Distribution of the pressure, temperature, and density in a solar hydrogen atmosphere.

[26] Since the temperature gradient, $-\frac{dT}{dh} = \frac{1}{P_0}$, was computed for the stratum within the photosphere, where $P_0 = 28.028$, it follows that in the higher strata, in which P has smaller values according to Table 11, the gradient will be greater in the proportion, $\left(-\frac{dT}{dh}\right)\frac{P_0}{P_n}$, assigning successive values to n in the several strata. Hence, the temperature fall is $-\Delta T_n = -\int \left(\frac{dT}{dh}\right)_n dh$, where $\left(\frac{dT}{dh}\right)_n$ increases toward the top of the solar atmosphere. Computations for the successive layers show that the temperature fall is slow up to the level of $P = 1$ atmosphere, beyond which it increases very rapidly as the density diminishes, so that the temperature of space is reached at the top of the inner corona.

We obtained the following temperatures:

Initial stratum in photosphere	$P = 28.028$, $T = 7652°$
Top of the photosphere	$P = 5.805$, $T = 7500°$
Top of the reversing layer	$P = 4.636$, $T = 7450°$
Top of the chromosphere	$P = 1.500$, $T = 6950°$

This law gives too low temperatures at the top of the inner corona to be acceptable at present. Referring to the earth's atmosphere, the law of cooling is not the adiabatic rate, but the gradient is nearly the same as that found for the lower strata in all levels up to 16,000 meters; that is to say, cooling takes place at a uniform rate. The law of cooling in the solar atmosphere is a function which is not now known, and it may fall between the two extreme types indicated above. The entire subject demands a careful research.

between 5 and 2 atmospheres, and in the midst of this the reversing layer and chromosphere are located. It is, therefore, probable that the action in the reversing layer which sends forth visible light waves is due to rapid transmissions in pressure and density, rather than to any changes of temperature. This favors the theory proposed for the explanation of the reversing layer by Becquerel, Wood, and Julius, namely, that it is due to contrasts of density, and in accordance with which the phenomenon has been reproduced in the laboratory. Compare pages 65 and 162, Eclipse Meteorology and Allied Problems, Weather Bureau Bulletin I.

The shifting and the broadening of the lines in the spectrum are due to a variation of pressure and density rather than to a change of temperature. It is also seen that the density of the hydrogen approaches zero at the height of the top of the inner corona. The coincidence in the observed boundaries of these layers in the sun's atmosphere with the results of this computation on the physical state is evidently so perfect as to argue strongly for the correctness of the physical constants employed. The outcome goes to show that the photosphere is the region where great changes in pressure are taking place, so that violent circulations, explosions, and chemical and electrical combinations must prevail, and observations show that this is the case. From the values here employed we can readily compute many other important thermodynamic relations.

TABLE 12.—*Computation of the pressures, temperatures, and densities at the surface and within the sun by Nipher's formulæ.*

		Numbers.	Logarithms.
	Fundamental constants.		
M	= total mass of the sun	2.0132×10^{33}	33.303878
$\frac{1}{k^2}$	= gravitation constant	1.5173×10^{7}	7.181073
r	= radius of the sun in centimeters	694800 80000.	10.841860
T	= absolute temperature at surface	7651.6°	3.883755
	Density at surface and within the sun.		
ρ	$= \frac{0.78}{4\pi}\cdot\frac{M}{r^3}$ = surface density	0.37255	9.571182
ρ	$= \frac{\rho_s}{3.86} = \frac{1.43287}{3.86}$ = surface density	0.37121	9.569621
ρ_s	= average density from astronomical data	1.43287	0.156208
r_s	$= 0.545\,r$ = distance of stratum ρ_s from center	3.7867×10^{10}	10.578257
v	$= \frac{1}{\rho}$ = specific volume at the surface	2.6842	0.428818
	Pressure at the surface and within the sun.		
P	$= \frac{0.636}{8\pi}\cdot\frac{M^2k^2}{r^4}$ = surface pressure	2.9004×10^{14}	14.462460
P_s	$= 5.40\,P$ = average pressure	1.5662×10^{15}	15.194854
r_s	$= 0.502\,r$ = distance of stratum P_s from center	3.4879×10^{10}	10.542564
	RT at the surface of the sun.		
RT	$= 0.818\,\frac{Mk^2}{2r}$	7.8103×10^{14}	14.892668
RT	$= Pv$ (The coefficient should be more fully developed.)	7.7854×10^{14}	14.891278
R	$= \frac{Pv}{T}$ = the gas constant	1.0175×10^{11}	11.007523
	Temperature at the surface and within the sun.		
T	$= 273\times28.028$	7651.6°	3.883755
T_s	$= 1.08\,T$	8263.8°	3.917179
r_s	$= 0.707\,r$	4.9122×10^{10}	10.691279
$-\Delta T$	$= 8263.8° - 7651.6° = 612.2°$	612.2°	2.786893
$+\Delta r$	$= 1.000\,r - 0.707\,r = 0293\,r$ in km.	203577.	5.308728
$-\frac{\Delta T}{\Delta r}$	= temperature gradient within the sun per 1000 meters	0.0030072	7.478165—10
	Mass of the sun.		
M	$= 1.22\,\frac{2RTr}{k^2}$ = mass	2.0091×10^{33}	33.302991
M	= Adopted value from Newcomb	2.0132×10^{33}	33.303878
	Weight of 1 gram at the surface of the sun.		
g	$= 1.22\,\frac{2RT}{r} = M\frac{k^2}{r^2}$	27428.	4.438178
g	$= 980.6\times28.028$	27484.	4.439084

TABLE 13.—*Transformation factor from perfect gases to the material of the sun within the photosphere.*

Formula $P_1 = \frac{P_s\rho_h}{\rho_s}$

	Numbers.	Logarithms.
P_s = surface pressure by Nipher's formula	2.9004×10^{14}	14.462460
ρ_h = density of hydrogen at surface of sun	0.000089996	5.954223—10
ρ_s = surface density by Nipher's formula	0.37255	9.571182—10
P_2 = corresponding pressure from inside	7.0065×10^{10}	10.845501
P_1 = pressure found from outside conditions	7.95967×10^{8}	8.900895
F = transformation factor	88.025	1.944606
R_2 = gas constant for P from Nipher's formula	1.0175×10^{11}	11.007523
R_1 = gas constant for P from hydrogen	1.1559×10^{9}	9.062917
F = transformation factor	88.025	1.944606

Some such factor as 88 is required to change the conditions outside the photosphere for perfect gases to those inside the photosphere for nonperfect gases or liquids.

TABLE 14.—*Specific heats c_p, c_v, quantity of heat Q, and work W, in the surface stratum of the sun.*

		Numbers.	Logarithms.
κ_p	$= \frac{\kappa}{\kappa-1} = \frac{3n-4}{2-2n}$	3.5	
κ_p	= assumed value	3.4615	0.539264
A	= heat equivalent of work	$\frac{1}{4.1855\times10^{7}}$	2.378253—10
R	= gas constant	1.0175×10^{11}	11.007523
AR	=	2431.0	3.385776
c_p	$= AR\,\frac{3n-4}{2-2n} = 3.5\,AR.$	8414.8	3.925040
	Assume $3.4615\,AR$		
$2c_p$		16829.6	
$3AR$		7293.0	
$4AR$		9724.0	
$-\left(\frac{dQ}{dT}\right)_n$	$= +(c_p + 4\,AR)$ specific heat due to contraction	18138.8	4.258609
n	$= \frac{2c_p + 4AR}{2c_p + 3AR} = 1.1$ closely	1.1008	0.041699
c	$= \frac{Q}{W} = \frac{c_p + 4AR}{2c_p + 3AR}$	0.7519	9.876184
	$= 0.75$ closely		
W	$= 0.636\,\frac{M^2k^2}{2r}$ = work of compression	1.2225×10^{33}	48.087250
Q	$= 0.7519\ W$ = heat radiated	0.9192×10^{33}	47.963434
$W-Q$	= excess of work energy over heat energy	0.3033×10^{33}	47.481872
$\frac{Q}{W-Q}$	=	3.03	0.481562
$\frac{W}{W-Q}$	=	4.03	0.605378
c_v	$= c_p - \frac{(8-5n)(4-3n)}{3(2-n)^2(5\kappa-3)}\cdot AR$	7977.2	3.901850
	$= c_p - 0.180\,AR$		
κ	$= \frac{c_p}{c_v} = \frac{8414.8}{7977.2}$	1.0548	0.023190

It may be observed that the Smithsonian Astrophysical Observatory computes from the Washington observations a tem-

perature of about 6000° for the atmosphere of the sun, although it is quite certain that a higher station, as Mount Whitney, would give a greater temperature, say 6500°. This, of course, takes account of the absorption in the earth's atmosphere, but not of that in the sun's atmosphere. It seems probable that the equivalent of 1000° C. may be absorbed from the stratum included between the midst of the photosphere and the top of the inner corona. If this is not the case, then the outgoing radiation of the sun must be such as to give nearly 4.0 gram-calories per square centimeter per minute on the outer surface of the atmosphere of the earth. The relative absorption in the atmospheres of the sun and the earth, respectively, will be much more readily determined if it can be admitted that the temperature of the sun about 7″ within the photosphere is approximately 7652°. In the following discussion the surface stratum is that which is 7″ below the visible boundary of the photosphere, where the pressure is taken as 28.028 atmospheres. The various comments made by Buckingham and Day as to the value of temperatures extrapolated from terrestrial to solar conditions have their importance, but it is believed that we shall be able to gain a footing by other processes, such as thermodynamic relations, and thereby determine the thermal condition of the sun without such an overstepping of the limits of the actual practicable experiments of the laboratory. We will proceed, in Tables 12 to 14, to consider the conditions within the solar mass, with the aid of Nipher's formulæ, and to show that here, too, there is ground for encouragement, because of the numerous agreements between two independent sets of data, namely, the astronomical quantities and the thermodynamic values.

DISCUSSION OF THE VALUES DERIVED FROM TABLES 12 TO 14.

Table 12, "Computation of the pressures, temperatures, and densities at the surface and within the sun by Nipher's formulæ," contains a series of values at the surface stratum in the photosphere, where the pressure has been taken at 28.028 atmospheres as the result of external conditions. These have now been computed from astronomical data M, k^2, r, and the assumed temperature 7651.6. The purpose is to compare these two sets of values, one computed from external conditions, and the other from the internal conditions, the former for strictly perfect gases, as hydrogen, and the latter from such non-perfect gases or liquid material as makes up the body of the sun. While the law $Pv = RT$ applies to perfect gases, we may yet obtain some approximate idea of the state of the sun inside the photosphere if a transformation factor can be found by which to pass from the first system to the second. In a circulating mass like the sun it is probable that something like this law applies throughout the mass. At any rate the view can be tested to some extent by studying the two sets of data. There is, of course, some danger of arguing in a circle through so complex a system of formulæ, but I think that the general conditions herein exhibited conform more closely to a natural solar mass than the results heretofore derived by the use of Ritter's formulæ.

The density.

The average density of the sun from astronomical data is 1.43287, and it is a denser liquid than water. The surface density is 0.37255, or about one-fourth the average density. This latter occurs at the distance $0.545r$ from the center of the sun, and if anything like the same gradient of density is maintained throughout, the density near the center of the sun is not far from 5.7, which is about the mean density of the earth. We may, therefore, assign a more or less solid nucleus to the sun, which becomes viscous at a distance of about one-third the radius from the center, and soon thereafter mobile. The transitions within the sun are gradual, but at the photosphere there is apparently a mixture of liquid and gaseous masses in active transitions, and these seem to be the conditions indicated by the phenomena observed in the sun spots. The prominences, faculæ, and the chromosphere are strictly in a gaseous atmosphere; the photosphere is a mixture of gases and liquids, and the interior consists of a circulating liquid passing into a solid nucleus near the center. While the sun's pressure by gravitation alone would increase the density of its constituents, the temperature is at the same time high enough to balance this tendency to compression, so that the material in the sun is in about the same state as the material of the earth, except that here the outer layers have advanced toward solidification under the prevailing low temperature. A contracting sun, in order to keep up its radiation, must be circulating freely, and this precludes a very high degree of viscosity, except near the center.

The pressure.

Beginning with a pressure of 28.028 atmospheres in that layer of the photosphere where the temperature is 7652°, which on the sun is equivalent to 7.96×10^8 dynes, we compute that for a hydrogen gaseous envelope the pressure practically vanishes at the top of the inner corona. Beyond this layer, into which hydrogen is ejected in the prominences, the conditions are favorable for all the electrical and magnetic phenomena belonging to the cathode rays in rarefied gases. At the photosphere, where the materials change from gases to vapors and liquids, there is a corresponding equivalent increase in pressure up to 2.90×10^{14} dynes. It would take this increase in pressure to pass from the gaseous to the fluid state at the high temperature there prevailing. If a fluid may be considered as a gas brought by pressure at a given temperature to the liquid condition, then this pressure difference also represents the explosive energy when the liquid changes to a gas. If the liquid is elevated from the interior to the surface of the sun by convection currents, then, on reaching the surface, it may greatly expand and even explode when vaporization takes place, as is commonly observed on the edge of the sun through the enormous velocities measured by the change in wave lengths, by the Doeppler principle, or by anomalous dispersion. Within the body of the sun, at the distance 0.5 radius from the center, the pressure is 1.57×10^{15} dynes, which is 5.4 times as much as at the surface. By the same ratio, the pressure would be eleven times as much at the center, though this law doubtless changes within the nucleus. The pressure is comparatively uniform below the sun's surface, and widely discontinuous at the surface. Hence, the convectional currents and the dependent phenomenon of rotation in latitude are leisurely motions compared with the explosive action at the surface layers.

The temperature and the gas constant.

Nipher's coefficients are carried to only three decimals, which is doubtless sufficiently accurate for the determination of the value of the contractional constant n. It is not quite sufficiently accurate, however, to give proper check values from one formula to another, but I have not thought it worth while to carry this computation beyond the approximate stage. If we pass from a perfect gas to a fluid, the value of the gas constant adopted must be interpreted as merely suggesting important relations, and too much emphasis must not be laid upon certain obvious criticisms which naturally arise. We may suppose that the mass of the sun beneath the photosphere, while apparently fluid or viscous, yet moves in accordance with the general law, by reason of convection, so that it is continually readjusting itself to conform somewhat closely to this general law of gaseous elasticity. At any rate, this is the theory upon which we have proceeded in the discussion. We compute the product $R\,T$ by Nipher's formula, and check it with the product $\frac{P}{\rho}$ found from the pressure and density, and then with the temperature $T = 7651.6°$ find $R = 1.0175 \times 10^{11}$ for the fluid of density 0.37255 in the surface layer. The temperature within the sun

at the distance 0.707 radius from the surface becomes 8264°, and at this rate, an increase of 612° in 0.293 radius, the total increase from the surface to the center is 2089°, making the central temperature 9741°. This gives an average gradient of —0.0030072° per 1000 meters from the center to the surface. We find, also, the gradient from the photosphere to the top of the inner corona to be —0.012563° per 1000 meters. The gradient of the temperature is about four times as great in the atmosphere of the sun as inside the photosphere. The cooling is, therefore, more rapid outside than it is inside the photosphere.

The mass of sun, the weight of 1 gram on the surface of the sun, and the transformation factor.

The mass of the sun is 2.0091×10^{33} by Nipher's formula, agreeing closely with that adopted from Newcomb, 2.0132×10^{33}, the former being computed through the product RT, and thus checking all the quantities. The weight of 1 gram at the surface of the sun is 27428 by Nipher's formula, through the product RT, and this agrees with the simple product $g = 980.6 \times 28.028 = 27484$, thus checking again. The transition factor from a perfect gaseous system to that actually existing at the surface, where the density is 0.37255, is found as indicated. We find the pressure corresponding to 0.37255 instead of that for which the computation was made in a hydrogen atmosphere of density 0.000089996, and obtain $P_2 = 7.0065 \times 10^{10}$ through Nipher's formula, as if the atmosphere were of the greater density. For the actual hydrogen atmosphere we computed (Table 13) $P_1 = 7.95967 \times 10^8$. Hence, $P_2 = 88.025\ P_1$, so that 88.025 is the required factor. Similarly, the gas constant from Nipher's formula is $R_2 = 1.0175 \times 10^{11}$. It was computed for the actual hydrogen atmosphere (Table 13) to be $R_1 = 1.1559 \times 10^9$. Again, $R_2 = 88.025\ R_1$, so that there is mutual agreement. Some such factor as 88 is required to pass from the law for perfect gases, $P_1 v = R_1 T$, to that for solar liquids, $P_2 v = R_2 T$.

It will not be advantageous to speculate as to what this factor 88 signifies, but it is not so large as to be improbable in passing from a gaseous to a fluid state, as it may stand for the internal forces of viscosity or friction and molecular cohesion, and possibly for some unknown forces of electricity and magnetism.

Specific heats, energy of radiation, and contraction.

Carrying the values of the several quantities through the various formulæ we find that they conform to the prescribed conditions, as follows:

Specific heat of contraction $-\left(\frac{dQ}{dT}\right)_n$		=	18138.8
Exponent and coefficient	n	=	1.1 closely.
Heat energy of radiation	Q	=	0.9192×10^{18}
Work energy of contraction	W	=	1.2225×10^{18}
Ratio $\frac{\text{heat radiated}}{\text{work of gravitation}} = c = \frac{Q}{W}$		=	0.75 closely.
Ratio $\frac{\text{heat radiated}}{\text{excess}} = \frac{Q}{W-Q}$		=	3.00 closely.
Ratio $\frac{\text{work of compression}}{\text{excess}} = \frac{W}{W-Q}$		=	4.00 closely.
Specific heat at constant pressure	c_p	=	8414.8
Specific heat at constant volume	c_v	=	7977.2
$\kappa = \frac{c_p}{c_v}$ ratio of the specific heats at the temperature 7652°		=	1.0548

We note that this ratio $\kappa = \frac{c_p}{c_v} = 1.4065$ in terrestrial conditions; in solar conditions inside the photosphere $\kappa = 1.0548$; and in the hydrogen envelope $\kappa = 1.000052$ according to the preceding discussion.

Surveying this set of interrelated thermodynamic values, and especially in view of the fact that they seem to conform so well with the known astrophysical conditions derived from observation, and with the astronomical data obtained by the general laws of motion, we conclude that they afford ground for further research. If they form the approximate basis for a sound solar physics they will become important in further meteorological studies.

THE TEMPERATURE ELEMENT OF THE CLIMATE OF BINGHAMTON, N. Y.

By W. E. DONALDSON, Observer, Weather Bureau.

[Condensed from a paper read before the Binghamton Academy of Science on March 1, 1904.

The climate of Binghamton is continental; the climate of Iceland is oceanic; the climate of Omaha, Nebr., is continental. As a result the January climate of the coast of Iceland is 11° warmer than the January climate of Omaha, and 7° warmer than the January climate of Binghamton. The July climate of the coast of Iceland is 26° cooler than the July climate of Omaha, and 21° cooler than the July climate of Binghamton. Thus the Binghamton climate occupies an intermediate position between the climate of Omaha and that of Iceland; though differing very slightly from the climate of Omaha, it differs decidedly from that of Iceland.

The normal mean temperature, by decades, has its minimum, 21°, in the first decade of February and its maximum, 72°, in the first decade of July.

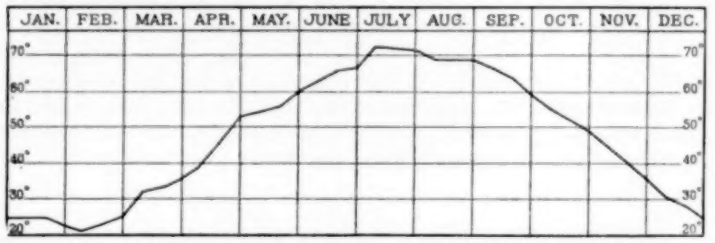


FIG. 1.—Normal annual temperature curve at Binghamton, N. Y., determined from seven years' record, October 1, 1896–September 30, 1903.

The change from winter to summer in this section is decidedly more rapid than the change from summer to winter. The normal annual temperature curve, fig. 1, is ascending 150 days and descending 215 days. This curve has a marked resemblance to the normal diurnal temperature curve in summer, fig. 2. The rapid rise from February 10 to July 10 resembles very closely the rapid rise from sunrise until about 2 p. m.; the slight change from July 10 to September 10 resembles the slight change from about 2 p. m. to 5 p. m.; the rapid fall from September 10 to December 31 resembles the rapid fall from about 5 p. m. to about 3 a. m., and the slight change from December 31 to February 10 resembles the slight change from about 3 a. m. to sunrise.

In the summer the diurnal temperature changes are in accordance with the diurnal variation in the intensity of insolation. The minimum temperature usually occurs at sunrise and the maximum about 3 p. m. The mean temperatures for individual summers closely approximate the normal for the summer. The regularity of the diurnal temperature curve day after day in summer and the close approximation of the mean temperatures of each summer to the normal summer temperature, result from the nonimportation of large masses of air from distant points.

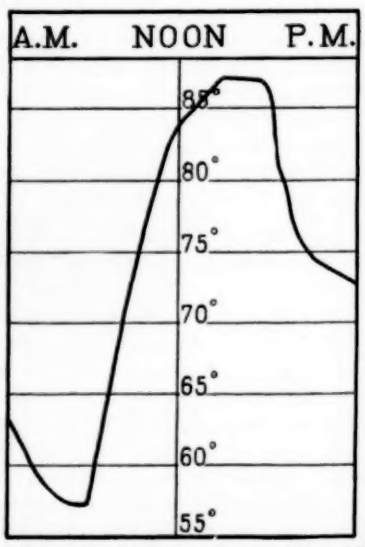


FIG. 2.—Summer type. Diurnal temperature curve on June 25, 1901.

In the winter the diurnal temperature curve, figs. 3, 4, and 5, frequently has no similarity to the diurnal variation in inso-

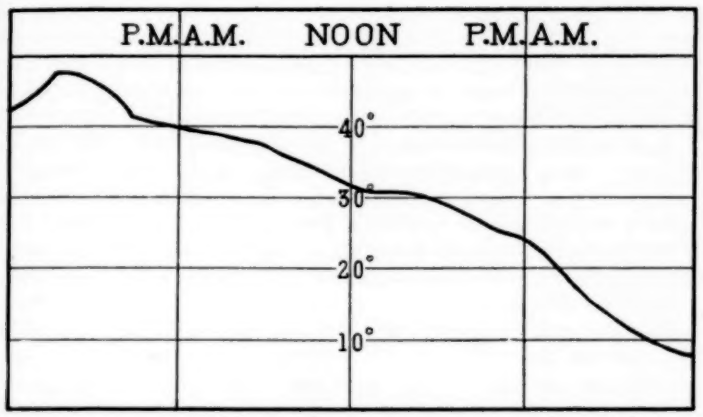


FIG. 3.—Winter type. Diurnal temperature curve; result of brisk northerly winds. Noon, January 16, to noon, January 18, 1901.

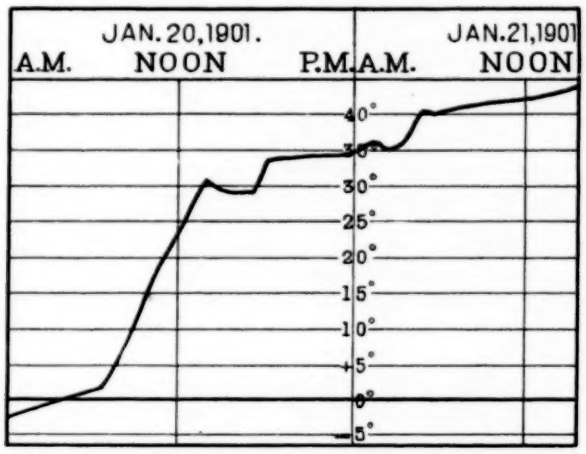


FIG. 4.—Winter type. Diurnal temperature curve; result of brisk southerly winds. January 20 and 21, 1901.

lation. The mean temperatures for individual winters depart decidedly from the normal winter temperature. The irregularity of the diurnal temperature curve in winter and the radical departure of the mean temperatures of individual winters from the normal winter temperature, result from the importation of large masses of air from far distant points.

In spring the temperature conditions recede from the winter types and gradually merge into the summer type. In autumn the temperature conditions recede from the summer type and gradually merge into the winter type.

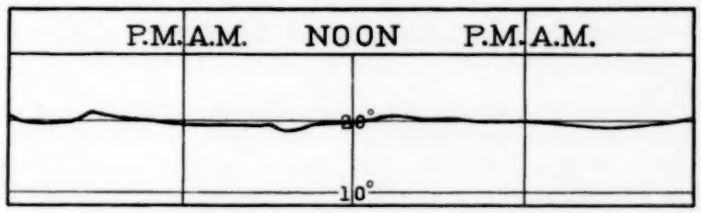


FIG. 5.—Winter type. Diurnal temperature curve; result of calm, cloudy weather. Noon, January 29, to noon, January 31, 1901.

SAMUEL M. BLANDFORD.

Section Director Samuel M. Blandford died February 9, 1904, at Boise, Idaho. Mr. Blandford was born June 15, 1866, in Prince George County, Md. His early education was obtained in the common schools and this was supplemented by the teaching of his father, Dr. J. H. Blandford. He enlisted in the meteorological service of the Army, October 15, 1887, and continued in that service until the organization of the Weather Bureau in 1891, when he was transferred to the civil establishment, in which he continued until his death. During his connection with the weather service Mr. Blandford served at various important stations, and by his integrity, fidelity, and ability won for himself the regard and commendation of those who knew him. His excellent work as an official was recognized by his assignment on September 19, 1898, to the charge of the important station at Boise.

NOTES AND EXTRACTS.

DESIRABILITY OF COMPLETE RAINFALL RECORDS.

The great importance of the study of rainfall and of the proper presentation of rainfall on our monthly and annual charts suggests that many will be pleased to examine the following table, which shows the number of regular and voluntary stations for which either complete or incomplete records were published in the respective monthly and annual section reports during the years 1901 and 1902. A complete record covers every day of the year, and is essential in making up normal values and departures from normals. Records of regu-

Total number of complete and incomplete records of precipitation at regular and voluntary stations of the Weather Bureau, as published in the monthly and annual section reports.

State or Territory.	Area in units of 1000 square miles.	Population per square mile.	Number of published records of precipitation.			
			1901.		1902.	
			Complete.	Incomplete.	Complete.	Incomplete.
Alabama	51.5	35.5	50	20	47	24
Arizona	112.9	1.1	44	20	40	21
Arkansas	53.0	24.7	46	17	42	24
California	155.7	9.5	176	25	185	15
Colorado	103.6	5.2	64	22	61	18
Connecticut	4.8	187.5	14	0	14	2
Delaware	2.0	94.3	3	2	4	0
District of Columbia			1	0	3	0
Florida	54.2	9.7	63	9	50	22
Georgia	59.0	37.6	66	28	57	39
Idaho	84.3	1.9	25	17	26	18
Illinois	56.0	86.1	84	3	79	24
Indiana	35.9	70.1	46	15	46	15
Indian Territory	31.0	12.6	*	*	*	*
Iowa	55.5	40.2	103	17	99	26
Kansas	81.7	18.0	65	19	66	28
Kentucky	40.0	53.7	41	12	38	22
Louisiana	45.4	30.4	43	14	33	19

Total number of complete and incomplete records, etc.—Continued.

State or Territory.	Area in units of 1000 square miles.	Population per square mile.	Number of published records of precipitation.			
			1901.		1902.	
			Complete.	Incomplete.	Complete.	Incomplete.
Maine	29.9	23.2	17	0	14	7
Maryland	10.0	120.5	37	20	36	13
Massachusetts	8.0	348.9	22	0	21	3
Michigan	57.4	42.2	106	21	109	23
Minnesota	79.2	22.1	54	17	55	13
Mississippi	46.3	33.5	36	19	43	14
Missouri	68.7	45.2	77	13	76	14
Montana	145.3	1.7	31	28	26	30
Nebraska	76.8	13.9	80	11	108	36
Nevada	109.7	0.4	35	4	17	27
New Hampshire	9.0	45.7	16	0	15	1
New Jersey	7.5	250.3	45	10	50	9
New Mexico	122.5	1.6	26	23	23	21
New York	47.6	152.6	75	22	93	15
North Carolina	48.6	39.0	49	13	49	16
North Dakota	70.2	4.5	43	4	26	12
Ohio	40.8	102.0	78	7	93	40
Oklahoma	38.8	10.3				
Oklahoma and Indian Territory	69.8	11.4	34	22	31	34
Oregon	94.6	4.4	63	31	64	23
Pennsylvania	45.0	140.1	69	23	69	18
Rhode Island	1.1	407.0	6	0	6	0
South Carolina	30.1	44.4	48	9	50	11
South Dakota	76.8	5.2	46	19	45	23
Tennessee	41.8	48.4	52	20	49	29
Texas	262.3	11.6	68	25	85	15
Utah	82.2	3.4	41	23	41	27
Vermont	9.1	37.6	13	1	12	2
Virginia	40.1	46.2	32	14	28	27
Washington	66.9	7.7	48	26	52	22
West Virginia	24.6	38.9	45	10	43	15
Wisconsin	54.4	38.0	41	28	49	17
Wyoming	97.6	0.9	28	20	31	17
Total			2,398	726	2,499	873

*See Oklahoma.

lar stations are complete unless destroyed by fire or other accident. Incomplete records may sometimes be completed hypothetically and used to fill up the details of a special chart, but they can not give us the annual or seasonal periodicity that is so important for many studies. In some sections the rain gages of the voluntary observers have all been inspected by the respective section directors; in other States this work is not yet quite complete. Practically all stations use gages of the standard Weather Bureau pattern having eight inches as the diameter of the inside of the rim of the receiver. The exposures are generally satisfactory to the inspector, and this means that the gages are not unduly sheltered by buildings and trees; if not satisfactory, the trouble is remedied if possible.

Owing to the changes that frequently take place among voluntary observers and stations, it must necessarily happen that some records begin and others stop in the midst of any given year, but as far as possible these breaks ought to be prevented, since a fragmentary year contributes so little to our knowledge as compared with a complete record.

The fact that the total number of rain gages at regular Weather Bureau stations is over 180, and at voluntary stations over 3000 may possibly lead one to think that we are providing fairly well for the collection of rainfall statistics, but when we consider that from these we received only 2000 complete station records, we must see that we are not doing nearly as well as is required by the urgent demand for information by those who are at work on the problems of river navigation, arid land irrigation, city water supply, and water power for manufacturing plants of all kinds. Every State and railroad in the country ought to follow the example of the California Railway Company, and maintain a large number of rain gages and records as a contribution to our knowledge of the climate of their localities.

Would it not be practicable to stimulate the keeping of complete rainfall records, and to diminish our large proportion of incomplete records, 25 per cent, by offering some special reward or honor? Mr. Symons adopted this plan in order to build up his great British rainfall system. The result was about 1000 complete rainfall station records for 40 continuous years, so that we know the laws of rainfall in Great Britain better than for any other country. If we had 30,000 stations, instead of 3000, it would not be too many for the great area of the United States.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart VIII and the average values and departures from normal are shown in Tables I and VI.

A ridge of mean barometric pressure, with readings of 30.15, or higher, extended from the Canadian border of northeastern Montana, North Dakota, Minnesota, Michigan, and the lower Lake region, southward and southeastward to the Gulf coast of Louisiana, Mississippi, and Alabama, to the central portion of the Peninsula of Florida, and to the coast of the south Atlantic and middle Atlantic districts. The crest of mean pressure, with a reading of 30.26 inches, overlay the Valley of the Red River of the North.

The mean pressure was low over Washington, Oregon, and the western portions of the middle and northern Plateau regions, with a minimum mean pressure of 29.69 inches reported from the region of the San Juan de Fuca Strait.

The mean pressure was below the normal over the Pacific and Plateau and practically all of the slope districts, and above the normal in all districts to the eastward of the slope region.

The mean pressure was .10 inch, or more, below the normal over the northern and middle Plateau regions, the deficiency increasing toward the westward and northward until it amounted to —.31 inch over the northwestern portion of Washington.

The greatest positive departures from the normal amounted to + .15 to + .18 inch, and occurred over the upper Lake region, North Dakota, and the northern portion of the upper Mississippi Valley.

The mean pressure decreased from that of the preceding month over the region to the westward of a line drawn from southeastern Lousiana northwestward to the Canadian border of central Montana, and over Maine; in all other districts the pressure increased.

The decrease in pressure was, as a rule, marked, and increased from —.10 inch over the central portion of the slope regions and southern portion of the Plateau regions westward and northwestward until it amounted to slightly more than —.40 inch on the coast of Washington.

The increase in pressure over the preceding month was not so marked, the maximum changes occurring over the Lake region, the greatest excess, + .15 inch, being reported from the central Lake Superior region.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart V.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	19.5	— 6.5	—12.5	— 6.2
Middle Atlantic	12	27.1	— 7.4	—13.5	— 6.8
South Atlantic	10	45.0	— 4.0	— 8.7	— 4.4
Florida Peninsula *	8	63.3	+ 0.8	— 1.2	— 0.6
East Gulf	9	52.9	— 0.3	— 3.3	— 1.6
West Gulf	7	54.0	+ 2.4	+ 2.9	+ 1.4
Ohio Valley and Tennessee	11	33.2	— 5.0	— 8.9	— 4.4
Lower Lake	8	17.4	— 9.1	—15.8	— 7.9
Upper Lake	10	8.7	—10.2	—15.5	— 7.8
North Dakota *	8	— 1.3	— 9.3	—10.3	— 5.2
Upper Mississippi Valley	11	18.9	— 7.2	—10.8	— 5.4
Missouri Valley	11	21.1	— 3.3	— 2.3	— 1.2
Northern Slope	7	21.0	— 0.1	+ 6.4	+ 3.2
Middle Slope	6	36.7	+ 4.2	+ 6.1	+ 3.0
Southern Slope *	6	47.2	+ 6.6	+ 5.9	+ 3.0
Southern Plateau *	13	46.9	+ 5.5	+ 5.4	+ 2.7
Middle Plateau *	8	34.4	+ 4.3	+ 2.9	+ 1.4
Northern Plateau *	12	32.6	+ 3.7	+ 9.3	+ 4.6
North Pacific	7	39.8	— 0.8	+ 1.6	+ 0.8
Middle Pacific	5	48.6	— 0.6	+ 0.4	+ 0.2
South Pacific	4	53.8	+ 0.4	+ 2.0	+ 1.0

* Regular Weather Bureau and selected voluntary stations.

To the eastward and northward of a line drawn from the north-central portion of Florida northwestward to the Canadian Provinces, north of western Montana, the mean temperature for the month was below normal; and above the normal to the southward and westward of that line.

The maximum deficiencies occurred in the upper Lake region, and the maximum excesses in the southeastern portion of the northern Plateau region.

The mean temperature was decidedly below the normal in New England, the Middle Atlantic and South Atlantic States, Ohio Valley and Tennessee, Lake region, and the upper Mississippi and Missouri Valleys, and markedly above the normal in the Plateau and southern and middle slope regions, and west Gulf States. In the east Gulf States, and northern slope,

and north and middle Pacific districts the mean for the month was slightly below normal, and slightly above in the Florida Peninsula and south Pacific district.

East of the Rocky Mountain slope region the isotherms of mean temperature lay to the southward of their position in February, 1903; the isotherms of maximum temperature slightly to the northward, and the isotherms of minimum generally slightly to the northward.

The maximum temperature for the month exceeded the record by 1° at Little Rock, Ark.; Palestine, Tex.; Wichita, Kans.; Yuma, Ariz., and Meridian, Miss.; by 2° at Pueblo, Colo., and Valentine, Nebr.; by 4° at El Paso and Fort Worth, Tex.; by 5° at Dodge, Kans.; by 9° at Abilene and Amarillo, Tex., and by 10° at Oklahoma, Okla.

In Canada.—Prof. R. F. Stupart says:

The mean temperature of February was decidedly below average throughout the Dominion, and to the greatest extent in Alberta where the negative departure amounted to 17°. At Calgary the mean temperature was —2°, the lowest monthly mean on record, excepting February, 1887, and January, 1890. Edmonton reports a mean of —8°, and the only months with a lower mean temperature were January, 1886, with —14°, and February, 1887, with — 10°. Farther east in the Territories, and in Manitoba, lower means have been recorded in several years. Dawson City reports a mean temperature of —26°, about 6° below average, and depth of snow on the ground 30 inches.

Eastward from Alberta the negative departures became less pronounced, and were but 5° or 6° in Manitoba. In Ontario, east of Lake Huron and the Georgian Bay, the departure from average ranged between 9° and 12°. There are indications, however, that northward from the Ottawa River and Lake Superior the departures from average diminished quickly, and the James Bay temperature was probably above average. In the Province of Quebec and the Maritime Provinces the negative departures ranged between 6° and 10°, except in the Gaspé Peninsula where it was somewhat less.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

The precipitation was above the normal in west-central Colorado, Utah, Idaho, except the southwestern portion, western Montana, Washington, Oregon, and northern and central California, and in small areas in the following States: Southeastern Alabama, southeastern South Carolina, east-central North Carolina, east-central Maine, northwestern New York, and southeastern lower Michigan; elsewhere it was below the normal. The maximum excess occurred in the western portions of California, Oregon, and Washington; and the maximum deficiency in the central and lower Mississippi, and lower Ohio valleys, and western Tennessee.

By geographic districts the precipitation was normal in the Florida Peninsula, and lower Lake region; above normal in North Dakota, and the Pacific, and northern and middle Plateau regions; and below normal in the remaining districts.

Precipitation ranging in amounts from 6 to somewhat more than 45 inches occurred in northern California, and the western portions of Oregon and Washington, and 6 to 9 inches in west-central Georgia, and southeastern Alabama.

The southern limit of snowfall extended to the southern border of South Carolina, below but near to the northern border of Georgia, Alabama, and Mississippi, and to southern Arkansas, and central Texas. No snowfall during the month was reported from southern California.

At the end of the month there was snow on the ground in New England, northern portion of the Middle Atlantic States, Lake region, North Dakota, the northern portions of the upper Mississippi and Missouri valleys, northern and middle slope and Plateau regions, and northern portion of the north Pacific district.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 7, 29. Arizona, 5, 17. Arkansas, 6, 7, 19, 20. California, 4, 5, 6, 7, 8, 12, 15, 25, 26, 27, 28. Connecticut, 6, 13, 22. Florida, 1. Georgia, 7. Idaho, 12, 22, 23, 26, 28. Illinois, 7, 17, 20, 29. Indiana, 6, 7, 18, 29. Indian Territory, 6, 7. Kansas, 6, 7. Kentucky, 7, 18, 19. Maine, 22, 29. Michigan, 2, 26, 29. Mississippi, 29. Missouri, 6, 7, 17, 29. Montana, 26. New Hampshire, 6, 7, 28. New Mexico, 16. New York, 6, 7, 22, 24, 28, 29. North Carolina, 7, 10, 14, 16, 19, 25, 26, 27. Ohio, 7, 18, 22, 23, 29. Oregon, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 19, 21, 22, 26, 27, 28, 29. Pennsylvania, 14, 28, 29. Rhode Island, 6, 15, 28. South Carolina, 8. Tennessee, 7, 19, 26, 29. Texas, 6, 7, 17, 18. Utah, 16, 28. Vermont, 21, 28, 29. Virginia, 9, 10, 15, 18, 19, 21, 26, 27. Washington, 4, 5, 6, 8, 11, 16, 19, 22, 24, 25, 26, 27, 28, 29. West Virginia, 28.

SLEET.

The following are the dates on which sleet fell in the respective States:

Arizona, 6. Arkansas, 11, 17, 18, 19, 20, 21. California, 4, 6, 7, 8, 11, 12, 16, 21, 22, 26, 27, 28. Connecticut, 14, 19. District of Columbia, 14, 18, 19. Florida, 11. Georgia, 1, 10, 11, 14, 20, 21. Idaho, 8, 12, 20, 21. Illinois, 1, 7, 8, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28. Indiana, 2, 17, 18, 19, 21, 22, 26. Indian Territory, 18, 19, 20. Iowa, 5, 6, 7, 9, 17, 18, 22, 23, 25, 26, 27, 28, 29. Kansas, 6, 9, 16, 17, 18, 19, 20. Kentucky, 7, 9, 10, 11, 16, 17, 18, 19, 20, 22, 25, 26, 27. Louisiana, 20. Maine 1, 6, 7, 28. Maryland, 14, 15, 18, 19, 21, 22, 26, 28. Massachusetts, 6. Michigan, 6, 7, 21, 27, 28, 29. Minnesota, 5, 6, 7, 23, 27. Mississippi, 19, 21. Missouri, 6, 7, 16, 17, 18, 19, 20, 21. Montana, 12, 15, 16, 22, 23, 26. Nebraska, 16, 17, 18, 22, 23, 24, 27. Nevada, 7, 16, 23, 24, 27. New Hampshire, 6, 7, 22, 28. New Jersey, 1, 6, 14, 18, 19, 24, 28, 29. New York, 3, 5, 6, 7, 14, 15, 22, 24, 28, 29. North Carolina, 10, 11, 14, 18, 19, 20, 21, 26, 27, 28. North Dakota, 22. Ohio, 1, 2, 5, 18, 19, 21, 23, 26, 29. Oklahoma, 18. Pennsylvania, 5, 6, 14, 19, 21, 24, 27, 28, 29. Rhode Island, 6, 19. South Carolina, 10, 11, 21. South Dakota, 6, 21, 22, 23. Tennessee, 2, 10, 14, 17, 18, 19, 21. Texas, 16, 18, 19, 20, 21. Utah, 12, 13, 16, 17, 19, 21, 23, 27, 28. Vermont, 28. Virginia, 9, 10, 14, 15, 18, 19, 21, 25, 26. Washington, 16, 19. West Virginia, 3, 4, 14, 18, 19, 21, 26, 27, 28. Wisconsin, 3, 4, 5, 6, 7, 23, 27, 28, 29. Wyoning, 12, 17.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	2.59	70	—1.1	—1.4
Middle Atlantic	12	2.01	57	—1.5	—2.2
South Atlantic	10	3.06	79	—0.8	—1.5
Florida Peninsula*	8	3.10	100	0.0	+2.6
East Gulf	9	2.99	61	—1.9	—3.5
West Gulf	7	1.78	50	—1.8	—3.9
Ohio Valley and Tennessee	11	2.39	54	—2.0	—3.6
Lower Lake	8	2.87	100	0.0	+1.5
Upper Lake	10	1.51	79	—0.4	—1.2
North Dakota*	8	0.77	135	+0.2	+0.1
Upper Mississippi Valley	11	0.87	44	—1.1	—1.1
Missouri Valley	11	0.48	38	—0.8	—0.9
Northern Slope	7	0.51	84	—0.1	—0.3
Middle Slope	6	0.10	12	—0.7	—0.9
Southern Slope*	6	0.10	11	—0.8	—0.8
Southern Plateau*	13	0.52	51	—0.5	—1.4
Middle Plateau*	8	2.22	168	+0.9	+0.6
Northern Plateau*	12	2.37	151	+0.8	—0.1
North Pacific	7	9.20	159	+3.4	+2.1
Middle Pacific	5	8.06	189	+3.8	+0.2
South Pacific	4	3.36	126	+0.7	—1.6

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The precipitation was very generally above the average, the only large district showing a deficiency being New Ontario, where there was no rain and the snowfall was light. British Columbia stations show an excess, with a much larger snowfall than usual, and in the Northwest Territories and Manitoba it was wholly in the form of snow, which was heavier and more frequent than usual in nearly all districts except south-

ern Alberta and eastern Manitoba. In Ontario the snowfall was not excessive, and there were several rainy days. The heaviest snowfall occurred on the last day of the month, when from 10 to 15 inches fell in most districts, but near Lake Erie there was heavy rain and sleet. In Quebec and the Maritime Provinces the precipitation was nearly average; in the former province and northern New Brunswick it fell as snow except on one day, and in the Maritime Provinces it was partly rain and partly snow, the latter predominating.

CLEAR SKY AND CLOUDINESS.

The distribution of clear sky is graphically shown on Chart IV, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

The cloudiness was normal in the middle slope region; below normal in New England, the Middle Atlantic and west Gulf States, Florida Peninsula, Ohio Valley, and Tennessee, Lake region, North Dakota, and the southern slope region, and above normal in the remaining districts.

Over Florida, southeastern New York, New Jersey, the southwestern quarter of the country generally, and North Dakota, the percentage of clear sky ranged from 50 to 70 per cent of the possible, and over the remainder of the country generally from 20 to 50 per cent. The smallest percentage of clear sky was reported from the northern Pacific region.

The average cloudiness for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.4	− 0.1	Missouri Valley	5.8	+ 0.4
Middle Atlantic	5.5	− 0.1	Northern Slope	5.7	+ 0.9
South Atlantic	5.4	+ 0.1	Middle Slope	4.4	0.0
Florida Peninsula	3.8	− 0.8	Southern Slope	3.9	− 0.9
East Gulf	6.0	+ 0.5	Southern Plateau	3.6	+ 0.6
West Gulf	5.1	− 0.7	Middle Plateau	6.2	+ 1.4
Ohio Valley and Tennessee	6.1	− 0.1	Northern Plateau	7.3	+ 0.6
Lower Lake	6.6	− 0.2	North Pacific	8.5	+ 1.5
Upper Lake	5.7	− 0.6	Middle Pacific	7.7	+ 2.9
North Dakota	4.9	− 0.2	South Pacific	5.5	+ 1.4
Upper Mississippi Valley	6.0	+ 0.7			

HUMIDITY.

The relative humidity was normal in the middle Plateau region; above normal in the Florida Peninsula, Lake region, upper Mississippi, and Missouri valleys, and the northern slope and Pacific districts; in the remaining districts it was below the normal.

In the Middle Atlantic States and middle and southern slope regions the deficiency was quite marked, especially in the last-named district where it amounted to 16 per cent. In the middle and south Pacific districts the excess in humidity was quite decided.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	74	− 1	Missouri Valley	76	+ 1
Middle Atlantic	69	− 5	Northern Slope	75	+ 4
South Atlantic	74	− 2	Middle Slope	62	− 5
Florida Peninsula	81	+ 1	Southern Slope	52	−16
East Gulf	76	− 1	Southern Plateau	40	− 4
West Gulf	73	− 1	Middle Plateau	64	0
Ohio Valley and Tennessee	72	− 2	Northern Plateau	73	− 2
Lower Lake	82	+ 2	North Pacific	85	+ 1
Upper Lake	84	+ 2	Middle Pacific	82	+ 6
North Dakota	77	− 3	South Pacific	78	+ 9
Upper Mississippi Valley	79	+ 2			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Bismarck, N. Dak	1	50	nw.	North Head, Wash	4	84	se.
Block Island, R. I	1	78	nw.	Do	10	70	s.
Do	2	66	nw.	Do	11	90	s.
Do	3	51	w.	Do	18	65	se.
Do	8	54	nw.	Do	19	50	sw.
Do	10	53	nw.	Do	22	62	sw.
Do	11	53	nw.	Do	26	61	s.
Do	16	57	w.	Do	27	62	s.
Do	25	60	nw.	Do	28	72	s.
Buffalo, N. Y	2	60	w.	Point Reyes Light, Cal	4	73	s.
Do	3	56	w.	Do	11	64	se.
Do	4	52	w.	Do	12	62	se.
Do	7	66	w.	Do	15	60	se.
Do	22	54	w.	Do	16	50	nw.
Cairo, Ill	7	66	sw.	Do	24	59	s.
Carson City, Nev	15	52	sw.	Do	26	60	s.
Charlotte, N. C	7	52	sw.	Port Crescent, Wash	12	51	sw.
Cheyenne, Wyo	1	60	nw.	St. Louis, Mo	7	62	sw.
Cleveland, Ohio	2	60	sw.	Sioux City, Iowa	1	53	nw.
Do	7	50	sw.	Do	2	61	nw.
Columbus, Ohio	2	59	w.	Southeast Farallon, Cal	4	50	s.
Denver, Colo	1	51	nw.	Do	12	50	s.
El Paso, Tex	6	56	w.	Syracuse, N. Y	14	51	s.
Fort Smith, Ark	6	54	w.	Do	21	50	s.
Hatteras, N. C	1	50	w.	Do	28	56	s.
Do	11	51	n.	Tatoosh Island, Wash	9	60	e.
Helena, Mont	1	51	sw.	Do	10	56	e.
Independence, Cal	22	60	w.	Do	11	69	e.
Knoxville, Tenn	7	50	w.	Do	12	66	sw.
Lexington, Ky	7	50	w.	Do	14	69	e.
Modena, Utah	5	58	sw.	Do	15	54	e.
Mount Tamalpais, Cal	4	56	sw.	Do	19	64	sw.
Do	12	50	s.	Do	21	63	sw.
Do	15	58	s.	Do	22	78	sw.
Do	16	67	nw.	Do	25	50	e.
Do	17	50	nw.	Do	27	60	s.
Do	22	56	sw.	Do	28	68	s.
New York, N. Y	1	60	nw.	Do	29	50	sw.
Do	3	58	nw.	Valentine, Nebr	1	52	nw.
Do	8	54	nw.	Williston, N. Dak	1	68	nw.
Do	16	54	nw.	Winnemucca, Nev	4	57	s.
Do	25	62	nw.	Do	12	52	s.
North Head, Wash	3	71	se.				

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 1125 thunderstorms were received during the current month as against 802 in 1903 and 427 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 7th, 446; 28th, 164; 29th, 133.

Reports were most numerous from: Ohio, 154; New York, 93; Missouri, 78.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: January 28 to February 5, inclusive.

In Canada: Thunderstorms were reported from Kingston, 28; Toronto, 28, 29; Port Stanley, 7, 28; Hamilton, Bermuda, 9.

Auroras were reported from Grand Manan, 5; Father Point, 5; Quebec, 5, 11; White River, 5, 6; Port Arthur, 15; Minnedosa, 16; Edmonton, 9, 15; Prince Albert, 16, 17, 21; Battleford, 15; Port Simpson, 14.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

Table I gives, for about 137 Weather Bureau stations making two observations daily and for about 31 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,800 stations occupied by voluntary and other cooperating observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station, the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . . .).

Table III gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions of the wind based on these two observations only and without considering the velocity. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I.

Table IV gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table V gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes.....	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates per hour (ins.).....	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table VI gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

Table VII gives the heights of rivers referred to zeros of gages; it is prepared by the Forecast Division.

NOTES EXPLANATORY OF THE CHARTS.

Chart I, tracks of centers of high areas, and Chart II, tracks of centers of low areas, are prepared by the Forecast Division. The roman numerals show number and chronological order of highs (Chart I) and lows (Chart II). The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the observations at 8 a. m. and 8 p. m., seventy-fifth meridian time. Within each circle is also given (Chart I) the highest barometric reading and (Chart II) the lowest barometric reading at or near the center at that time, and in both cases as reduced to sea level and standard gravity.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all by 0.0.

Chart IV.—Percentage of clear sky. The average cloudiness at each Weather Bureau station is determined by numerous personal observations during the day. The difference between the observed cloudiness and 100, it is assumed, represents the percentage of clear sky, and the values thus obtained have been used in preparing Chart VII.

Chart V.—Surface temperatures; maximum, minimum, and mean of these. Lines of equal monthly mean temperature in red; lines of equal maximum temperature in black; and lines of equal minimum temperature (dotted) also in black.

Chart VI. Isobars and isotherms at 10,000 feet. The mean monthly station pressure for each station has been reduced to the 10,000-foot plane by entering Table 53, pages 789–988, Volume II, Annual Report of the Chief of the Weather Bureau, 1900–1901, with the temperature argument, t, corresponding to θ_2, and correcting the station pressure by the reduction $B_2 - B$ after applying the plateau correction, $C. \Delta \theta. H$, and the corrections for e and ΔA, the argument t being the mean monthly air temperature. This reduction is fully described in the Annual Report of the Chief of the Weather Bureau for 1900–1901, Volume II, pages 772 to 786. The reduction for obtaining B_2 may also be found by using gradients from the station pressure to the height of 10,000 feet, as set forth on pages 18 and 19 of the MONTHLY WEATHER REVIEW for January, 1902.

The isotherms on the 10,000-foot plane have been computed by using the gradients for temperature for each month and station as shown by Table 48, Chapter VIII, Volume II, Report of the Chief of the Weather Bureau, 1900–1901.

Chart VII.—Isobars and isotherms at 3500 feet. The pressure and temperature data entered on this chart are found by the method described for similar data on the 10,000 foot plane.

Chart VIII.—Isobars and isotherms at sea-level and resultant surface winds. The pressures have been reduced to sea level and standard gravity by the method described by Prof. Frank H. Bigelow on pages 13–16 of the REVIEW for January, 1902. The pressures have also been reduced to the mean of the twenty-four hours by the application of a suitable correction to the mean of the 8 a. m. and 8 p. m. readings, at stations taking two observations daily, and to the 8 a. m. or 8 p. m. observation, respectively, at stations taking but a single observation. The diurnal corrections so applied will be found in Table 27, Volume II, Annual Report of the Chief of Weather Bureau, 1900–1901, pp. 140–164.

The isotherms on the sea-level plane have been constructed by means of the data summarized in chapter 8 of the Annual Report of the Chief of the Weather Bureau for 1900–1901, Volume II. The correction $t_0 - t$, or temperature on the sea-level plane minus the station temperature, as given by Table 48 of the above report, is added to the observed surface temperature to obtain the adopted sea-level temperature.

The resultant wind directions are computed from observations at 8 a. m. and 8 p. m. daily. The resultant durations are shown by figures attached to the arrows.

IX.—Isobars at sea-level; surface isotherms; resultant winds.

Chart X.—Hydrographs for seven principal rivers of the United States, prepared by the Forecast Division.

Chart XI.—The total snowfall. This is based on the reports from regular and voluntary observers, and shows the depth of the snowfall during the month in inches. In general, the depth is shown by lines inclosing areas of equal snowfall, but in special cases figures are also given.

Chart XII.—Depth of snow on ground at end of month.

When there is no snow the last two charts are omitted.

TABLE I.—*Climatological data for Weather Bureau stations, February, 1904.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
New England.							19.5	— 6.5											74	2.59	— 1.1								5.4	
Eastport	76	69	82	29.91	30.00	+ .02	14.4	— 7.6	44	22	22	—11	2	7	29	13	10	84	3.97	+ 0.1	18	10,333	nw.	45	s.	22	11	7	11	5.4	21.0
Portland, Me	103	81	117	29.93	30.06	+ .04	15.7	— 8.9	45	22	23	—10	9	8	28	14	9	76	2.35	— 1.2	11	6,483	nw.	36	sw.	22	11	7	11	5.3	15.6
Concord	298	70	79	29.74	30.08	+ .04	15.2	— 8.2	45	22	25	— 7	21	5	45	....	....	....	1.71	— 1.6	11	4,529	nw.	34	w.	8	11	4	14	5.7	14.5
Northfield	876	16	60	29.10	30.10	+ .06	10.6	— 5.4	53	7	21	—18	2	0	44	8	2	72	0.56	— 1.9	11	6,663	n.	36	nw.	8	10	7	12	5.8	3.2
Boston	125	115	181	29.94	30.08	+ .04	22.6	— 5.4	49	22	31	— 1	10	14	33	20	14	70	2.49	— 1.2	11	8,558	w.	40	w.	1	12	5	12	5.2	16.5
Nantucket	12	43	82	30.06	30.07	+ .03	25.4	— 5.6	46	22	32	2	10	19	28	24	20	78	3.86	+ 0.9	15	11,386	nw.	47	nw.	1	6	9	14	6.6	19.1
Block Island	26	11	46	30.07	30.10	+ .04	25.0	— 5.8	49	22	32	4	16	18	32	23	18	73	3.12	— 1.4	10	16,120	nw.	78	nw.	1	10	10	9	5.1	3.4
Narragansett	.....	9	38	.....	.....	.....	23.2	— 5.9	48	22	32	1	16	14	32	....	....	....	2.73	— 1.8	9	.....	nw.	....	....	..	13	5	11	....	10.0
New Haven	106	116	154	30.01	30.14	+ .07	23.0	— 5.8	51	8	32	0	16	14	41	20	13	67	2.52	— 1.7	8	7,357	n.	36	nw.	25	17	5	7	3.8	5.7
Mid. Atlantic States.							27.1	— 7.4											69	2.01	— 1.5								5.5	
Albany	97	102	115	30.05	30.17	+ .10	17.0	— 7.2	46	7	26	— 4	10	8	37	14	11	81	1.17	— 1.6	9	6,404	nw.	33	se.	28	12	6	11	5.2	8.2
Binghamton	875	79	90	29.18	30.15	+ .07	17.0	— 6.9	56	7	26	— 6	10	8	43	....	....	....	1.16	— 1.7	11	6,097	nw.	29	nw.	7	6	12	11	6.1	4.2
New York	314	108	350	29.79	30.14	+ .06	25.0	— 6.5	53	7	33	1	16	17	33	21	13	61	2.18	— 1.8	8	12,393	nw.	62	nw.	25	14	6	9	4.7	5.6
Harrisburg	374	94	104	29.78	30.20	+ .11	23.2	— 9.3	53	7	31	0	16	16	26	20	15	71	1.54	— 1.4	14	6,416	nw.	41	nw.	24	9	7	13	5.5	2.5
Philadelphia	117	116	184	30.06	30.19	+ .09	27.4	— 6.1	57	7	36	5	17	19	32	23	17	66	2.21	— 1.1	10	8,312	nw.	36	nw.	1	10	7	12	5.4	5.8
Scranton	805	111	119	29.27	30.18	+ .10	20.1	.....	55	7	29	— 4	16	11	35	17	10	66	0.92	.....	11	6,472	sw.	31	nw.	25	7	10	12	6.1	1.8
Atlantic City	52	39	48	30.12	30.18	+ .07	26.5	— 7.4	52	24	34	2	17	19	30	23	17	70	2.08	— 1.4	10	6,754	nw.	31	nw.	25	9	13	7	4.9	4.9
Cape May	17	47	51	30.18	30.20	+ .09	27.5	— 8.2	50	7	34	6	17	21	27	24	....	....	2.02	— 1.9	10	7,149	nw.	36	nw.	25	11	10	8	5.1	5.6
Baltimore	123	69	117	30.05	30.19	+ .08	28.6	— 7.6	64	7	37	5	17	21	30	24	17	64	1.50	— 2.1	9	5,950	nw.	38	nw.	3	9	7	13	5.6	2.5
Washington	112	59	76	30.08	30.21	+ .10	28.4	— 7.4	63	7	37	2	2	20	38	24	16	63	1.65	— 1.8	10	5,788	nw.	38	nw.	25	10	7	12	5.4	1.8
Cape Henry	18	11	58	30.08	30.20	+ .09	35.4	— 8.5	77	7	43	14	17	28	31	....	....	....	3.15	— 0.6	12	11,849	n.	48	n.	11	10	8	11	5.9	8.5
Lynchburg	681	83	88	29.41	30.19	+ .08	33.0	— 7.0	64	7	42	3	2	24	40	28	22	68	1.91	— 1.7	8	3,882	nw.	35	nw.	25	13	6	10	5.0	5.1
Norfolk	91	102	111	30.10	30.21	+ .10	35.8	— 7.0	76	7	43	12	17	28	32	31	26	70	3.56	— 0.4	13	7,820	n.	42	sw.	7	10	8	11	5.7	10.2
Richmond	144	82	90	30.05	30.22	+ .11	34.2	.....	68	7	43	9	17	26	35	....	....	....	2.71	.....	11	4,503	n.	32	sw.	7	9	8	12	5.7	8.4
Wytheville	2,293	40	47	27.72	30.19	+ .07	31.4	.....	67	29	41	6	17	22	34	27	23	77	2.08	.....	11	5,129	w.	36	w.	24	8	10	11	5.6	4.4
S. Atlantic States.							45.0	— 4.0											74	3.06	— 0.8								5.4	
Asheville	2,255	53	75	27.78	30.17	+ .04	37.0	— 2.7	74	29	47	4	2	27	46	32	27	74	2.06	— 1.5	8	7,157	nw.	35	nw.	22	5	17	7	5.9	0.8
Charlotte	773	68	76	29.35	30.21	+ .09	39.6	— 5.4	71	7	48	19	11	32	28	34	26	65	3.42	— 1.2	12	6,018	ne.	52	sw.	7	9	8	12	5.6	1.6
Hatteras	11	12	47	30.18	30.19	+ .08	42.0	— 4.6	65	•	49	19	17	35	35	39	37	84	3.52	— 1.1	11	13,174	ne.	51	n.	11	8	10	11	5.6	0.5
Raleigh	376	71	79	29.80	30.22	+ .11	38.3	— 5.6	76	7	48	15	2	29	31	33	27	70	4.22	+ 0.3	12	5,473	ne.	33	nw.	7	10	10	9	5.1	3.7
Wilmington	78	82	90	30.10	30.19	+ .07	43.8	— 6.0	74	29	54	21	13	34	34	38	33	73	2.19	— 1.2	10	6,792	n.	38	nw.	1	10	9	10	5.6	T.
Charleston	48	14	92	30.16	30.21	+ .09	49.4	— 3.4	76	24	57	28	11	42	27	43	38	74	3.57	+ 0.1	10	7,876	ne.	38	ne.	20	6	14	9	5.7	T.
Columbia, S. C	351	167	175	29.81	30.21	+ .10	44.4	— 3.7	73	7	53	22	11	36	28	39	33	72	3.01	— 1.3	12	7,714	ne.	46	nw.	7	8	8	13	6.1	
Augusta	180	89	97	30.00	30.20	+ .08	46.4	— 4.0	75	7	56	24	2	37	34	40	34	71	3.05	— 1.1	10	4,863	ne.	36	nw.	7	10	9	10	5.1	
Savannah	65	79	89	30.12	30.20	+ .08	52.0	— 2.3	81	7	61	29	12	43	29	45	41	75	2.87	— 0.3	8	b,872	ne.	33	nw.	1	11	10	8	5.0	T.
Jacksonville	43	101	129	30.11	30.16	+ .04	56.6	— 1.8	80	7	66	33	12	47	28	50	46	80	2.70	— 0.6	9	6,679	ne.	36	nw.	1	14	10	5	4.1	
Florida Peninsula.							67.7	+ 0.6											81	2.13	— 0.4								3.8	
Jupiter	28	10	48	30.11	30.14	+ .06	68.5	+ 1.4	83	22	75	44	2	62	24	63	60	81	2.10	— 0.7	6	7,922	se.	34	nw.	1	11	16	2	4.3	
Key West	22	10	53	30.09	30.11	+ .04	71.0	— 0.4	82	22	76	52	2	66	16	65	63	81	1.08	— 0.6	4	7,106	ne.	33	nw.	1	17	9	3	3.4	
Sand Key	24	.....	.....	30.07	30.10	.....	71.1	.....	83	11	75	56	2	68	18	....	....	....	1.17	.....	4	11,645	e.	44	nw.	1	14	11	4	3.8	
Tampa	34	60	67	30.11	30.15	+ .05	63.5	+ 0.7	83	28	73	37	2	54	28	56	54	81	3.20	+ 0.1	8	4,147	ne.	33	w.	1	17	6	6	3.8	
East Gulf States.							52.9	— 3.3											70	2.99	— 1.9								6.0	
Atlanta	1,174	190	216	28.92	30.19	+ .07	43.4	— 4.6	71	7	51	23	1	36	23	38	32	70	3.51	— 1.3	13	9,230	nw.	44	nw.	1	8	7	14	6.3	T.
Macon	370	93	99	29.79	30.20	+ .08	48.0	.....	74	7	57	27	2	39	35	....	....	....	4.07	.....	13	4,999	nw.	28	sw.	7	8	6	15	6.0	
Pensacola	56	79	96	30.09	30.15	+ .04	56.8	0.0	72	29	63	33	12	51	22	....	....	....	2.20	— 1.9	12	6,764	ne.	36	nw.	1	6	11	12	6.0	
Birmingham	700	136	143	29.40	30.18	+ .06	48.3	— 0.9	76	29	57	25	12	39	30	....	....	....	2.14	— 2.3	8	7,125	n.	32	se.	20	8	9	12	5.9	
Mobile	57	88	96	30.09	30.15	+ .04	55.7	+ 0.9	73	28	63	32	12	48	24	51	18	80	4.01	— 0.9	8	5,399	s.	26	nw.	1	6	15	8	5.7	
Montgomery	223	100	112	29.93	30.16	+ .04	51.9	— 0.8	81	27	61	30	12	43	32	47	44	80	5.78	+ 0.2	11	5,103	e.	49	w.	7	8	9	12	5.9	
Meridian	375	84	93	29.75	30.16	+ .05	52.2	— 1.4	81	27	62	28	13	42	40	....	....	....	2.98	— 2.8	9	5,004	ne.	22	sw.	2	8	10	11	5.7	
Vicksburg	247	62	74	29.84	30.11	+ .01	54.8	+ 2.2	81	29	64	30	12	46	29	47	41	68	1.78	— 3.1	9	6,181	e.	25	s.	7	8	7	13	6.0	
New Orleans	51	88	121	30.07	30.13	+ .04	60.3	+ 2.2	82	29	68	36	1	52	29	55	51	80	1.52	— 3.2	7	6,532	s.	27	n.	10	5	13	11	6.4	
West Gulf States.							54.0	+ 2.4											73	1.78	— 1.8								5.1	
Shreveport	249	77	84	29.82	30.10	+ .01	53.8	+ 2.6	81	29	63	30	20	45	31	47	42	68	1.99	— 2.3	5	6,070	s.	28	s.	6	10	8	11	5.3	
Fort Smith	457	79	94	29.60	30.09	— .01	44.6	+ 3.1	79	28	54	24	11	35	34	39	32	66	0.85	— 2.9	5	7,804	e.	54	w.	6	9	13	7	4.6	1.5
Little Rock	357	93	100	29.75	30.14	+ .03	45.6	+ 0.2	79	28	55	23	11	37	30	40	33	65	3.13	— 2.4	5	6,917	ne.	40	nw.	18	8	7	14	5.8	
Corpus Christi	20	48	53	30.04	30.06	+ .01	60.8	+ 1.8	80	24	68	32	11	53	31	55	53	83	1.37	— 1.2	6	7,915	se.	34	s.	6	8	13	8	5.2	
Fort Worth	670	106	114	29.36	30.08	+ .01	52.2	.....	96	25	64	23	11	40	40	....	....	....	1.79	.....	3	9,241	s.	36	sw.	1	20	3	6	3.4	T.
Galveston	54	106	112	30.02	30.08	+ .01	57.8	+ 0.8	76	7	63	37	21	53	18	55	54	92	0.99	— 2.1	10	8,830	s.	30	ne.	10	11	7	11	5.1	
Palestine	510	73	79	29.54	30.08	.00	55.6	+ 4.6	83	29	65	28	11	46	30	49	44	72	3.50	— 0.1	5	6,478	s.	32	s.	6	6	12	11	6.0	
San Antonio	701	80	91	29.31	30.04	— .01	59.6	+ 3.8	90	24	72	30	12	47	36	51	44	64	0.64	— 1.4	5	5,736	se.	34	n.	18	12	7	10	5.0	
Taylor	583	55	63	29.45	30.07	+ .01	56.6	.....	90	24	69	25	12	44	41	....	....	....	1.12	.....	4	8,341	s.	36	s.	13	8	11	10	5.6	
Ohio Val. and Tenn.							53.3	— 3.0											72	2.39	— 2.0								6.1	
Chattanooga	762	106	112	29.38	30.21	+ .08	42.3	— 3.2	74	29	51	21	2	34	34	37	30	65	2.08	— 3.4	10	6,058	s.	38	w.	7	8	8	13	6.0	0.6
Knoxville	1,004	35	88	29.10	30.19	+ .07	40.1	— 2.2	70	29	49	13	2	31	34	35	28	69	4.42	— 1.1	11	5,888	n.	50	w.	7	7	13	9	5.7	0.1
Memphis	397	146	154	29.74	30.18	+ .07	44.4	— 0.4	77	28	53	23	20	36	30	39	32	65	1.31	— 4.2	6	8,696	ne.	40	s.	7	16	3	10	4.8	
Nashville	546	122	134	29.59	30.19	+ .07	40.4	— 2.3	73	29	50	16	3	31	37	36	30	69	1.24	— 4.2	9	6,654	s.	36	sw.	7	7	12	10	5.8	T.
Lexington	989	75	102	29.09	30.20	+ .09	31.2	— 5.0	67	29	40	5	16	22	35	....	....	....	2.38	— 1.5	9	10,039	s.	50	w.	7	6	14	9	6.0	3.5
Louisville	525	114	136	29.61	30.21	+ .10	33.0	— 5.2	68	6	42	8	16	24	40	30	24	71	3.54	— 1.0	6	8,107	n.	45	sw.	2	8	12	9	5.5	3.5
Evansville	431	72	82	29.70	30.18	+ .07	32.2	.....	67	7	40	3	1	24	41	....	....	....	2.53	.....	6	6,770	ne.	41	w.	2	5	15	9	6.0	2.3
Indianapolis	822	154	164	29.27	30.19	+ .09	25.0	— 7.3	65	29	34	— 3	4	16	38	23	21	85	2.75	— 1.0	10	8,747	n.	41	w.	2	11	8	10	5.7	4.9
Cincinnati	628	152	160	29.50	30.21	+ .11	28.9	— 7.5	67	29	38	0	16	20	38	26	21	71	2.66	— 1.2	11	6,636	w.	36	w.	2	5	9	15	6.9	1.8
Columbus	824	173	190	29.27	30.19	+ .10	24.8	— 7.3	65	29	34	— 5	16	16	37	22	19	80	2.12	— 1.7	13	10,377	sw.	59	w.	2	6	10	13	6.1	5.0
Pittsburg	842	116	123	29.24	30.18	+ .09	25.8	— 7.6	61	7	35	— 5	16	16	39	22	17	72	2.00	— 0.9	13	5,013	nw.	33	nw.	2	5	11	13	6.7	4.5
Parkersburg	638	77	84	29.51	30.22	+ .12	28.8	— 7.5	71	29	38	— 1	16	19	39	26	22	74	1.79	— 2.0	13	5,805	nw.	41	nw.	2	5	7	17	7.1	7.7
Elkins	1,940	41	50	28.04	30.16	+ .06	27.9	.....	68	29	40	— 9	17	16	50	24	19	74	3.18	.....	21	4,093	w.	26	sw.	2	4	8	17	7.3	18.0
Lower Lake Region.							17.4	— 9.1											82	2.87	0.0								6.6	
Buffalo	767	178	206	29.29	30.16	+ .10	16.8	— 7.7	50	7	24	— 8	16	9	38	15	9	71	4.32	+ 1.4	25	12,550	w.	66	w.	7	2	5	22	8.3	18.2
Oswego	335	76	91	29.76	30.16	+ .10	15.4	— 9.2	52	7	24	— 7	9	7	34	15	13	89	3.11	+ 0.5	20	9,566	nw.	42	nw.	7	4	7	18	7.6	19.3
Rochester	523	81	102	29.56	30.16	+ .10	16.3	— 8.1	53	7	24	— 5	16	9	38	15	12	83	2.65	— 0.2	21	8,446	w.	45	w.	7	4	12	13	6.8	17.2
Syracuse	597	97	113	29.48	30.16	+ .09	15.4	.....	55	7	23	— 7	9	8	35	....	....	....	2.24	.....	18	10,917	w.	56	s.	28	3	14	12	6.7	15.6
Erie	713	92	102	29.37	30.18	+ .11	18.4	— 9.1	57	7	26	— 8	16	10	40	16	13	84	2.90	— 0.7	17	9,318	n.	47	w.	28	3	7	19	7.1	7.1
Cleveland	762	190	201	29.32	30.19	+ .12	18.7	— 9.3	57	7	27	— 8	16	11	40	17	13	79	2.95	0.0	22	12,535	se.	60	sw.	2	5	8	16	6.9	7.8
Sandusky	629	62	70	29.46	30.18	+ .11	19.6	— 9.3	56	7	27	— 6	16	12	39	....	....	....	1.96	— 1.1	11	7,595	sw.	40	nw.	7	13	7	9	4.9	1.8
Toledo	628	120	127	29.48	30.19	+ .12	17.9	—10.3	53	7	26	— 7	16	10	38	16	12	78	2.53	+ 0.4	11	8,273	w.	36	w.	2	12	6	11	5.1	2.1
Detroit	730	153	193	29.35	30.18	+ .12	16.1	—10.1	45	7	23	— 9	16	9	38	15	13	88	2.55	+ 0.1	15	9,151	ne.	39	w.	7	8	6	15	6.0	5.8
Upper Lake Region.							8.7	—10.2											84	1.51	— 0.4								5.7	
Alpena	609	63	80	29.49	30.20	+ .17	7.2	—10.8	39	28	17	—18	8	— 3	38	5	3	87	1.99	— 0.1	12	7,301	nw.	36	se.	13	12	7	10	5.3	19.2
Escanaba	612	40	48	29.51	30.22	+ .16	4.8	—11.0	38	28	14	—21	17	— 4	40	3	2	95	1.43	— 0.2	13	4,570	n.	31	n.	7	16	5	8	4.5	18.7
Grand Rapids	707	127	165	29.38	30.20	+ .15	14.6	— 8.8	48	7	23	—10	16	6	42	13	11	87	1.78	— 0.8	14	7,991	nw.	35	w.	24	9	7	13	6.4	11.9
Houghton	668	66	74	29.44	30.21	+ .16	3.5	.....	39	20	12	—27	8	— 5	47	....	....	....	2.37	.....	10	5,279	nw.	31	nw.	24	15	5	9	4.8	25.0
Marquette	734	76	116	29.37	30.23	+ .18	6.4	—10.7	35	28	14	—14	8	— 1	25	4	0	79	1.48	— 0.4	13	7,165	nw.	38	se.	27	9	9	11	5.7	18.4
Port Huron	638	70	120	29.47	30.20	+ .15	13.4	— 9.6	46	6	21	—12	16	6	40	12	9	83	1.43	— 1.1	14	8,689	nw.	43	w.	7	10	6	13	5.8	3.7
Sault Ste. Marie	614	40	61	29.45	30.18	+ .15	2.4	—10.1	37	28	11	—27	8	— 7	33	1	—1	87	1.22	— 0.1	11	6,647	nw.	45	w.	24	11	7	11	5.3	12.2
Chicago	823	241	274	29.27	30.21	+ .13	17.2	— 9.6	53	6	24	— 6	1	10	42	16	13	83	1.71	— 0.6	14	12,998	ne.	48	w.	2	5	10	14	7.1	13.4
Milwaukee	681	124	142	29.43	30.21	+ .15	13.8	— 8.9	44	6	21	—10	1	6	31	12	8	78	1.39	— 0.5	13	8,572	w.	32	ne.	29	6	10	13	6.3	14.7
Green Bay	617	49	86	29.51	30.22	+ .16	6.6	— 9.6	38	28	16	—17	17	— 3	31	5	1	76	1.43	— 0.4	11	6,798	n.	36	ne.	23	6	10	13	6.0	16.5
Duluth	1,133	11	47	28.91	30.23	+ .15	1.0	—12.5	33	27	10	—24	1	— 8	30	—1	—4	82	1.25	+ 0.1	12	9,429	ne.	46	nw.	21	12	8	9	5.2	14.7

TABLE I.—*Climatological data for Weather Bureau stations, February, 1904*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.			Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
North Dakota.							— 1.1	— 3.3									77	0.83	+ 0.2									4.9	
Moorhead	935	54	60	29.16	30.26	+ .15	— 0.2	— 4.7	40	27	9	—26	8	—10	30	—2	— 4	89	1.18	+ 0.3	12	7,875	se.	40	se.	1	13	6	10	5.1	11.8
Bismarck	1,674	16	29	28.32	30.25	+ .13	— 0.2	— 9.7	42	27	9	—28	11	—10	43	—3	—11	63	0.72	+ 0.1	9	7,404	se.	50	nw.	1	14	5	10	4.8	7.2
Williston	1,875	14	44	28.04	30.17	+ .06	— 2.8	—10.5	41	27	9	—33	15	—15	55	—4	— 7	80	0.59	+ 0.2	5	5,909	e.	68	nw.	1	12	9	8	4.7	8.3
Upper Miss. Valley.							13.9	— 7.2									79	0.87	— 1.1									6.0	
Minneapolis	.....	99	208	.....	.....	.....	5.2	—11.0	36	27	13	—19	8	—3	28	.....	.....	.....	0.75	— 0.3	13	7,954	nw.	35	nw.	2	9	8	12	.....	13.2
St. Paul	837	102	122	29.26	30.23	+ .14	6.2	— 9.6	38	27	14	—18	1	—2	31	5	2	85	0.76	— 0.2	12	5,576	nw.	28	nw.	13	12	6	11	5.2	7.7
La Crosse	714	71	87	29.41	30.24	+ .16	10.2	— 9.9	42	28	19	—16	1	1	32	.....	.....	.....	0.57	— 0.6	8	5,286	n.	31	n.	2	10	9	10	5.4	7.5
Davenport	606	71	79	29.50	30.19	+ .09	17.2	— 8.1	61	6	26	— 8	1	9	34	16	13	82	0.72	— 0.9	8	6,525	ne.	35	w.	2	4	11	14	6.7	6.8
Des Moines	861	84	99	29.25	30.23	+ .12	16.7	— 6.4	47	6	26	— 9	1	8	41	15	12	82	0.22	— 1.1	6	6,735	nw.	31	nw.	2	4	13	12	6.9	3.5
Dubuque	698	100	117	29.42	30.22	+ .13	14.4	— 8.2	58	6	23	—11	1	6	34	12	8	77	0.73	— 0.8	8	5,719	nw.	32	nw.	2	10	13	6	5.2	6.2
Keokuk	614	63	78	29.48	30.18	+ .07	21.6	— 6.7	67	6	29	—11	1	14	39	19	15	78	0.70	— 1.1	5	6,348	n.	42	nw.	2	8	10	11	5.8	3.1
Cairo	356	87	93	29.79	30.19	+ .07	36.2	— 3.2	74	28	45	11	1	28	42	33	29	76	1.70	— 2.4	6	8,426	n.	66	sw.	7	2	12	15	6.9	1.7
Springfield, Ill	644	82	93	29.47	30.19	+ .09	23.9	— 6.4	63	6	32	— 5	1	16	36	21	18	83	1.49	— 2.0	7	8,299	nw.	39	w.	2	3	12	14	6.7	4.6
Hannibal	534	75	109	29.58	30.18	+ .07	25.0	— 5.5	69	6	33	— 5	1	17	36	.....	.....	.....	1.12	— 0.9	9	7,645	n.	36	nw.	2	9	8	12	5.7	4.4
St. Louis	567	208	217	29.54	30.17	+ .06	30.8	— 4.3	69	7	40	2	1	22	47	27	21	71	0.84	— 2.0	5	9,140	ne.	62	sw.	7	11	5	13	5.7	2.5
Missouri Valley.							21.1	— 3.3									76	0.48	— 0.8									5.8	
Columbia, Mo	784	11	84	29.28	30.14	+ .03	28.5	— 6.7	67	6	38	2	1	19	39	.....	.....	.....	1.01	— 1.4	5	7,328	ne.	38	w.	2	5	7	17	7.1	1.4
Kansas City	963	78	95	29.10	30.18	+ .07	29.0	— 2.0	70	6	38	7	4	20	45	26	21	77	0.69	— 1.2	6	6,490	nw.	30	nw.	2	12	7	10	5.0	0.5
Springfield, Mo	1,324	98	104	28.68	30.12	+ .01	36.2	+ 1.5	76	28	46	13	11	26	44	31	27	75	0.85	— 2.3	3	9,559	se.	38	se.	17	18	6	5	3.9	1.4
Topeka	.....	85	89	.....	.....	.....	28.6	— 2.7	71	6	39	6	11	19	51	.....	.....	.....	0.16	— 1.6	3	7,242	n.	34	nw.	2	10	8	11	5.5	0.4
Lincoln	1,189	75	84	28.84	30.18	+ .08	22.0	— 1.4	63	5	33	— 4	8	11	45	18	13	71	0.07	— 0.9	3	8,306	ne.	44	nw.	2	12	10	7	5.3	0.7
Omaha	1,105	115	121	28.95	30.20	+ .09	19.8	— 5.2	60	5	30	— 5	8	10	47	17	13	78	0.10	— 0.7	5	7,477	n.	38	nw.	2	6	11	12	6.2	1.0
Valentine	2,598	47	54	27.30	30.15	+ .06	20.3	— 1.2	68	27	33	—12	9	8	43	15	10	71	0.22	— 0.6	10	7,733	nw.	52	nw.	1	7	8	14	5.9	1.9
Sioux City	1,135	96	164	28.92	30.21	+ .09	14.6	— 4.4	58	5	26	—13	8	3	53	.....	.....	.....	0.33	— 0.2	4	10,115	nw.	61	nw.	2	6	9	14	6.3	3.9
Pierre	1,572	43	50	28.43	30.20	+ .09	11.3	— 4.1	46	27	20	—20	9	3	36	9	5	77	0.83	+ 0.4	12	6,015	e.	40	nw.	1	4	10	15	6.9	9.4
Huron	1,306	56	67	28.73	30.22	+ .10	6.6	— 5.4	40	27	16	—23	8	—3	34	5	3	86	0.45	— 0.2	11	9,786	nw.	47	se.	12	6	6	17	6.8	4.8
Yankton	1,233	42	49	28.82	30.22	+ .10	14.8	— 4.4	58	5	26	—15	8	3	54	.....	.....	.....	0.53	— 0.2	7	6,337	nw.	40	nw.	1	10	14	5	4.8	4.3
Northern Slope.							21.0	— 0.1									75	0.51	— 0.1									5.7	
Havre	2,505	11	44	27.30	30.10	+ .03	3.6	— 9.6	47	1	15	—29	10	—8	48	1	0	90	0.57	0.0	11	5,366	e.	40	nw.	1	9	12	8	5.8	5.7
Miles City	2,371	42	50	27.42	30.05	— .04	12.0	— 4.2	46	1	22	—16	10	2	34	10	9	96	0.30	— 0.2	7	3,981	n.	46	w.	1	10	8	11	5.7	2.8
Helena	4,110	88	94	25.63	29.97	— .14	21.2	— 0.5	52	26	31	— 9	9	11	42	18	12	72	0.67	— 0.1	10	4,930	sw.	51	sw.	1	8	7	14	6.1	9.4
Kalispell	2,965	45	51	26.72	29.85	— .23	25.6	.....	44	22	34	— 1	10	18	28	23	20	78	1.90	.....	18	3,821	w.	30	sw.	22	8	10	11	5.9	17.2
Rapid City	3,234	46	50	26.54	30.08	— .00	18.0	— 2.6	62	22	31	—19	10	5	58	15	11	80	1.00	+ 0.4	7	5,203	w.	40	w.	27	9	9	11	5.3	9.4
Cheyenne	6,088	56	64	23.87	29.94	— .09	34.0	+ 6.7	63	27	47	5	18	21	33	26	14	48	0.33	— 0.1	3	9,521	w.	60	nw.	1	4	16	9	6.1	3.0
Lander	5,372	26	36	24.49	29.95	— .13	29.4	+ 6.4	58	26	43	— 5	10	16	40	25	18	65	0.63	+ 0.1	3	3,891	sw.	36	sw.	16	7	19	2	4.8	6.3
Yellowstone Park	6,200	11	47	23.68	29.95	— .15	23.8	.....	42	26	32	— 4	18	15	33	21	16	72	1.50	.....	15	7,552	sw.	36	sw.	12	2	15	12	7.0	15.4
North Platte	2,821	43	52	27.09	30.13	+ .06	28.5	+ 3.2	73	27	44	— 2	8	13	59	21	16	72	0.06	— 0.4	1	6,126	se.	38	nw.	1	8	16	5	5.0	1.0
Middle Slope.							36.7	+ 4.2									62	0.10	— 0.7									4.4	
Denver	5,291	79	151	24.60	29.92	— .09	40.2	+ 8.0	73	27	54	12	8	27	40	31	21	51	0.17	— 0.4	1	6,615	s.	51	nw.	1	12	16	1	4.3	2.5
Pueblo	4,685	80	86	25.20	29.95	— .05	37.8	+ 7.7	74	25	54	6	9	21	54	29	15	46	0.31	— 0.2	2	5,797	nw.	48	w.	1	19	7	3	3.7	3.1
Concordia	1,398	42	47	28.63	30.16	+ .07	27.8	— 0.4	68	5	39	1	11	17	45	23	19	75	0.05	— 0.8	3	5,446	se.	30	s.	5	11	13	5	4.5	0.2
Dodge	2,509	44	54	27.41	30.09	+ .03	35.0	+ 3.2	83	27	51	5	10	19	53	26	19	65	0.02	— 0.6	1	7,360	n.	40	sw.	6	11	8	10	5.0	T.
Wichita	1,358	78	86	28.64	30.13	+ .05	35.5	+ 3.7	79	23	48	7	11	23	49	30	26	75	0.04	— 1.2	2	7,487	ne.	35	n.	6	14	11	4	4.5	T.
Oklahoma	1,214	79	86	28.75	30.06	— .01	43.8	+ 3.3	90	28	56	12	11	31	42	36	28	62	0.04	— 0.9	1	10,181	n.	42	n.	14	12	12	5	4.3	0.5
Southern Slope.							48.6	+ 7.9									52	0.18	— 1.0									3.9	
Abilene	1,738	45	54	28.21	30.04	— .01	52.2	+ 6.3	94	25	66	16	11	39	45	43	35	60	0.27	— 1.2	2	7,514	s.	34	w.	6	13	12	4	4.3	1.0
Amarillo	3,676	10	49	26.22	30.00	— .02	45.1	+ 9.5	84	25	62	8	10	29	46	32	18	45	0.08	— 0.8	1	10,034	sw.	48	sw.	6	18	11	0	3.5	0.8
Southern Plateau.							49.8	+ 5.0									40	0.48	— 0.4									3.6	
El Paso	3,762	10	110	26.18	29.97	+ .02	53.0	+ 3.6	86	24	70	21	1	36	47	37	17	30	0.01	— 0.4	1	7,384	nw.	56	w.	6	17	11	1	2.8	T.
Santa Fe	7,013	47	50	23.22	30.00	+ .02	38.7	+ 6.7	66	24	50	16	10	28	32	28	14	40	0.26	— 0.6	4	4,527	se.	25	nw.	22	16	13	0	2.7	2.7
Flagstaff	6,907	12	25	23.34	29.94	— .06	38.0	+ 6.6	66	24	52	— 5	6	24	44	31	25	64	1.12	— 0.8	5	.....	w.	46	sw.	5	9	15	5	4.7	5.3
Phoenix	1,108	50	56	28.82	29.98	— .01	58.9	+ 4.5	91	24	75	34	1	43	41	45	30	39	0.26	— 0.5	2	2,870	e.	28	sw.	5	18	8	3	3.1	
Yuma	141	16	46	29.82	29.97	— .03	61.8	+ 3.2	92	24	77	38	9	47	41	47	29	34	T.	— 0.5	0	3,925	n.	32	nw.	5	20	5	4	2.3	
Independence	3,910	51	58	25.94	29.94	— .12	48.5	+ 5.7	73	22	59	22	6	38	31	37	20	35	1.20	+ 0.6	4	5,473	nw.	60	w.	22	6	11	12	6.3	
Middle Plateau.							37.0	+ 3.7									64	2.60	+ 1.5									6.2	
Carson City	4,720	82	92	25.19	29.95	— .13	38.4	+ 1.9	61	3	48	6	6	29	38	35	30	74	5.85	+ 4.3	14	7,484	sw.	52	sw.	15	6	3	20	7.2	7.5
Winnemucca	4,344	59	70	25.52	29.95	— .14	36.0	+ 3.5	59	*	46	0	9	26	43	32	25	61	1.59	+ 0.6	9	9,661	sw.	57	s.	4	5	4	20	7.4	4.4
Modena	5,479	10	43	24.56	99.97	— .07	36.0	.....	66	22	50	— 6	10	23	43	30	21	57	1.01	.....	5	8,940	sw.	58	sw.	5	14	13	2	4.0	5.2
Salt Lake City	4,366	105	110	25.56	29.99	— .09	35.9	+ 3.0	66	24	45	6	10	27	26	31	24	62	2.25	+ 0.9	14	4,398	se.	42	n.	13	5	6	18	7.2	20.4
Grand Junction	4,608	43	51	25.34	29.96	— .08	37.7	+ 6.4	70	24	50	9	9	25	40	32	25	64	0.71	+ 0.1	4	3,234	nw.	32	s.	5	8	15	6	5.3	4.8
Northern Plateau.							36.0	+ 5.2									73	2.17	+ 0.5									7.3	
Baker City	3,471	53	59	26.29	29.92	— .20	31.4	+ 6.4	49	22	38	6	9	24	22	28	23	72	2.10	+ 0.3	20	5,100	se.	27	sw.	28	2	6	21	7.9	13.5
Boise	2,739	61	68	27.08	29.98	— .14	39.3	+ 4.7	62	4	47	18	9	32	28	35	29	68	1.47	— 0.2	16	4,768	se.	30	sw.	26	4	4	21	7.4	3.7
Lewiston	757	52	61	29.06	29.88	— .23	40.0	+ 1.5	56	4	47	21	9	33	22	.....	.....	.....	1.77	+ 0.5	15	3,043	e.	32	nw.	29	5	10	14	6.9	1.2
Pocatello	4,482	46	54	25.39	29.99	— .11	33.1	+10.1	55	22	41	10	10	26	25	28	21	59	2.00	+ 0.1	15	8,624	e.	37	sw.	1	4	11	14	6.7	6.1
Spokane	1,929	101	110	27.78	29.87	— .22	32.9	+ 4.4	44	22	38	7	9	27	19	31	28	82	2.83	+ 0.7	20	5,741	s.	33	s.	28	0	6	23	8.8	10.9
Walla Walla	1,000	65	71	28.79	29.88	— .23	39.3	+ 3.9	59	22	46	22	9	33	26	37	34	84	2.87	+ 1.5	16	5,075	s.	35	se.	10	6	9	14	6.3	4.0
N. Pac. Coast Reg.							39.6	— 0.8									85	9.20	+ 3.4									8.5	
North Head	211	11	56	29.55	29.78	— .28	40.8	— 0.9	52	4	46	27	8	36	18	40	39	89	9.79	+ 3.3	27	17,592	se.	90	s.	11	0	5	24	8.9	2.2
Port Crescent	259	12	29	29.43	29.71	— .32	36.5	— 1.3	50	21	42	16	9	31	25	.....	.....	.....	7.92	+ 3.1	22	4,123	se.	51	sw.	12	2	7	20	7.9	14.5
Seattle	123	114	151	29.68	29.81	— .25	40.2	— 1.2	54	21	44	27	9	36	16	38	35	82	5.31	+ 1.5	21	7,504	se.	45	se.	12	0	9	20	8.1	3.6
Tacoma	213	113	120	29.57	29.80	— .26	38.6	— 0.3	54	21	44	23	9	34	18	.....	.....	.....	7.57	+ 2.0	23	5,647	sw.	44	sw.	11	0	6	23	8.8	15.6
Tatoosh Island	86	7	57	29.59	29.69	— .31	39.4	— 1.4	50	21	43	26	7	35	13	38	36	87	10.52	+ 1.7	28	15,539	se.	78	sw.	22	3	1	25	8.8	5.2
Portland, Oreg	154	68	96	29.69	29.85	— .23	41.2	0.0	58	21	46	29	9	36	21	39	36	82	11.08	+ 4.8	26	5,122	sw.	29	sw.	28	0	5	24	8.9	1.5
Roseburg	518	56	67	29.34	29.91	— .19	41.6	— 0.5	58	21	48	30	18	35	25	39	36	83	12.19	+ 7.2	22	2,688	s.	28	s.	4	2	7	20	8.3	4.1
Mid. Pac. Coast Reg.							49.6	— 0.6									82	3.06	+ 3.8									7.7	
Eureka	62	62	80	29.93	30.00	— .11	46.2	— 0.2	56	22	51	33	9	41	18	44	41	82	16.10	+ 9.4	22	6,234	se.	40	se.	11	1	7	21	8.0	
Mount Tamalpais	2,375	11	18	27.35	30.03	— .05	43.1	.....	63	2	47	31	9	39	17	40	37	84	10.22	.....	20	12,987	nw.	67	nw.	16	3	9	17	7.5	1.3
Red Bluff	332	50	56	29.65	30.01	— .10	47.9	— 1.1	70	1	55	29	9	41	31	44	41	79	6.63	+ 2.8	15	5,546	se.	34	se.	15	6	8	15	6.8	
Sacramento	69	106	117	29.98	30.05	— .04	49.3	— 0.5	61	19	55	33	3	44	27	46	43	81	5.26	+ 2.0	16	6,070	se.	34	se.	12	4	8	17	7.5	
San Francisco	155	161	167	29.92	30.09	— .01	50.8	— 0.9	60	23	55	40	9	46	14	48	45	84	5.89	+ 2.1	16	5,561	w.	31	s.	15	1	10	18	7.6	
Point Reyes Light	490	7	50	.....	.....	.....	48.8	— 0.5	57	28	52	39	7	45	13	.....	.....	.....	6.40	+ 2.6	17	14,438	nw.	73	s.	4	0	10	19	8.4	
Southeast Farallon	30	9	17	30.02	30.05	.....	50.8	.....	57	29	53	44	5	49	9	...	...	...	6.13	.....	16	10,149	nw.	50	s.	12	3	5	21	7.9	
S. Pac. Coast Reg.							53.8	+ 0.4									78	3.36	+ 0.7									5.5	
Fresno	330	67	70	29.71	30.07	— .01	52.4	+ 2.2	72	22	61	31	10	44	33	47	42	70	2.49	+ 1.3	8	3,604	nw.	26	sw.	4	8	4	17	6.6	
Los Angeles	338	116	123	29.69	30.06	.00	55.6	+ 1.2	76	23	65	38	4	46	29	49	45	76	2.68	— 0.7	7	3,239	w.	19	s.	27	10	7	12	5.2	
San Diego	87	94	102	29.96	30.05	— .01	54.6	— 0.2	68	22	61	41	9	48	21	51	48	84	1.50	— 0.8	6	3,802	nw.	36	s.	5	16	5	8	4.4	
San Luis Obispo	201	46	48	29.87	30.09	— .02	52.8	— 1.5	74	23	61	33	10	45	35	49	45	80	6.79	+ 2.9	12	3,668	n.	22	w.	28	9	7	18	5.7	
West Indies.																														
Basseterre	29	41	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bridgetown	30	57	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cienfuegos	52	62	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grand Turk	11	6	20	30.05	30.06	.00	76.6	.....	86	1	82	64	*	71	18	.....	.....	.....	1.25	.....	7	.....	e.	.....	.....	.....	17	11	1	3.8	
Hamilton	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Havana	286	41	62	30.03	30.09	+ .03	71.2	— 0.8	84	7	78	58	2	65	18	.....	.....	.....	1.78	— 0.6	7	8,130	e.	40	ne.	4	15	6	8	3.9	
Puerto Principe	352	55	90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Juan	82	48	52	29.95	30.04	— .01	74.8	— 0.4	83	12	80	66	25	69	15	69	67	77	6.48	+ 4.0	23	9,144	e.	30	e.	5	12	14	3	4.7	

* More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, February, 1904.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Anniston	78	18	46.8	2.98	
Ashville	76	20	46.0	2.78	
Benton				7.36	
Bermuda	82	27	54.4	4.79	
Bridgeport				2.11	2.0
Burkeville				6.60	
Camphill	78	25	51.4	6.07	
Citronelle	81	31	56.7	3.46	
Clanton	75	28	49.8	6.39	
Cordova	80[4]	20[4]	46.8[4]	1.82	
Daphne	78	30	57.9	2.22	
Decatur	72	22	44.8	1.25	
Demopolis				4.10	
Dothan	83	24	53.9	3.20	
Eufaula	78	28	50.2	9.15	
Evergreen	79	27	54.8	6.69	
Flomaton	83	26	53.2	5.55	
Florence *a*				1.44	
Florence *b*	79	21	46.4	1.28	
Fort Deposit	82	28	51.2	7.95	
Gadsden	78	24	45.1	3.16	
Goodwater	74	26	47.4	4.70	
Greensboro	78	27	51.2	4.62	
Greenville				5.58	
Highland Home	84	28	53.4	6.52	
Livingston	78	26	48.4	4.44	
Lock No. 4	75	21	47.1	3.24	
Madison Station	76	23	47.2	1.60	
Maplegrove	76	19	44.0	3.26	
Marion	78	25	49.6	3.81	
Milstead				6.68	
Newbern	82	25	51.4	3.37	
Notasulga				6.32	
Oneonto	75	23	46.2	2.49	
Opelika	77	28	47.6	6.33	
Ozark	80	28	53.0	5.75	
Prattville	83	25	50.6	4.38	
Pushmataha	80	25	52.0	6.08	
Riverton	79	18	46.6	1.70	
Scottsboro	76	22	44.6	1.27	
Selma	82			4.58	
Spring Hill	74	34	57.0		
Talladega	78	23	48.2	3.90	
Tallassee				4.20	
Thomasville	79	28	50.2	5.63	
Tuscaloosa	79	26	47.5	2.21	
Tuscumbia	77	23	44.8	1.41	
Tuskegee	82	28	52.0	5.75	
Union Springs	79	28	51.5	5.87	
Uniontown	81	24	50.2	3.98	
Valleyhead	75	20	43.4	1.42	
Wetumpka	82	26	51.6	4.90	
Alaska.					
Copper Center	25	—47	—11.1	0.22	4.5
Fort Liscum	42	2	21.2	0.52	5.2
Killisnoo	38	7	19.3	1.25	12.5
Orca	88	8	25.4		
Sitka	43	10	25.5	0.43	2.0
Skagway	32	— 3	10.7	T.	
Arizona.					
Agua Caliente	95	28	58.2	0.02	
Allaire Ranch				0.17	T.
Arizona Canal Co's Dam	91	35	60.6	0.46	
Aztec	95	15	57.4	0.00	
Benson	85	20	53.4	0.55	0.5
Bisbee	84[c]	28[c]	54.1[d]	0.40	
Blue	75	8	43.4	0.72	3.0
Bowie	87	19[d]	51.8	0.26	T.
Casagrande	95			0.75	
Champie Camp	92	23	55.6	0.20	
Cochise *1	79	27	48.9	0.00	
Congress	81	33	57.4	0.39	
Douglas	89	15	51.5	0.10	
Dragoon *1	83	30	49.0	0.20	2.0
Dudleyville	91	26	55.5	0.66	T.
Duncan	85	7	46.2	0.00	
Fort Apache	78	11	44.0	0.60	6.0
Fort Defiance	65	1	32.9	0.42	4.2
Fort Grant	87	30	54.8	0.31	
Fort Huachuca	83	24	52.2	0.49	1.2
Fort Mohave	92	29	58.6	0.04	
Greaterville	81	18	51.1	0.70	8.0
Holbrook	78	12	44.8	0.37	3.0
Jerome	76	29	50.4	0.80	
Kingman	80	25	50.6	0.64	
Maricopa	90	22	53.6	0.30	
Mesa	95	33	58.3	0.26	
Mesa (near)	89	28	56.4	0.32	
Mohawk Summit *1	90	40	62.4	T.	
Natural Bridge				1.34	5.0
Nogales	88	20	53.5	0.76	1.0
Oracle	80	32	53.2	0.60	6.0
Oro				0.11	
Parker	96	25	58.7	0.00	
Phoenix	91	28	56.7	0.21	
Pinal Ranch				1.00	5.0
Prescott	66	5	39.6	0.50	3.0
St. Johns	78	8	42.2	0.30	3.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
San Carlos	90	18	53.2	0.43	
San Simon	88	10	49.5	0.25	
Sentinel *1	91	36	56.9	0.25	
Superstition				0.45	
Taylor	78	9	43.0	0.72	5.7
Thatcher	87	15	51.9	T.	
Tonto	84	28	53.8	0.74	
Tucson	91	24	56.2	0.54	
Upper San Pedro	87	11	46.6	0.50	
Vail *5	77	40	59.3	0.10	
Walnutgrove				0.02	
Wilcox	83	9	47.7	0.20	T.
Williams	71	— 3	41.4	0.30	3.0
Yarnell				0.50	2.5
Young	82	14	46.0	0.47	4.5
Arkansas.					
Alco	76	12	40.0	1.80	2.0
Amity	84	18	47.2	3.90	T.
Arkadelphia	80	23	48.0	3.44	2.0
Arkansas City				1.66	
Batesville	79	20	42.0	3.52	
Beebranch	78	17	44.0		
Blanchard	81	21	52.1	2.63	
Brinkley	79	22	44.1	1.66	
Camden *a*				3.18	
Camden *b*	81	25	49.8	2.55	
Conway	80	22	45.2	3.41	
Corning	77	19	39.0	2.16	0.6
Dallas	78	21	47.0	5.01	1.8
Dardanelle				1.90	
Des Arc	81	23	47.6	2.98	
Dodd City	80	12	39.2	0.65	4.0
Dutton	72	15	40.1	1.75	3.5
Elon				1.87	
Eureka Springs	78	17	42.4	0.60	2.5
Fayetteville	78[c]	15[c]	42.7[c]	0.89	2.0
Forrest City	77	10	41.8	2.20	
Hardy	78	16	40.4	2.07	1.0
Heber	80	11	43.3	2.14	T.
Helena *a*				1.58	
Helena *b*	78	25	47.4	1.13	
Hope	82	26	50.8	2.48	T.
Howe	84	23	50.2	4.38	
Jonesboro	82	13	42.8	3.80	0.2
Lake Village	82	26	50.6	2.42	
Lonoke		18[c]	45.2[c]	2.40	
Lutherville	73	16	40.8	1.52	
Malvern	80	21	46.0	2.39	1.0
Marvell	81	25	47.6	2.08	
Mossville	70	14	38.1	1.64	2.1
Mount Nebo	73	17	41.0	3.31	
New Gascony	81[f]	22[f]	49.2[f]	3.60	
New Lewisville	86[c]	22	52.6	2.39	
Newport *a*				3.49	0.5
Newport *b*	80	20	42.5	3.59	
Oregon	77	12	38.6	1.33	5.6
Ozark	81	21	44.2	1.81	2.0
Paragould	79	21	41.8	3.20	
Perry	84	20	45.3	4.30	2.0
Pinebluff	80	24	46.4	2.85	
Pocahontas	78	14	39.6	2.74	0.5
Pond	78	18[3]	44.9[c]	0.18	0.2
Prescott	83	23	48.3	2.47	
Princeton	81	19	48.6	3.63	
Russellville	77	21	40.0	3.47	0.7
Silversprings	79	14	43.0	0.53	2.2
Spielerville	80	22	44.6	2.42	2.5
Stuttgart	80	21	46.0	3.36	
Texarkana	81	25	51.8	2.36	
Warren	80	14	48.9	2.76	
Wiggs	77	12	45.4	2.64	
Winslow	72	20	41.8	0.52	
Witts Springs	67	13	35.8	1.46	T.
California.					
Angiola	80	30	57.2	1.40	
Azusa	82	32	55.4	2.75	
Bakersfield	80	24	53.8	1.85	
Barstow	84	38	59.2	0.30	
Bear Valley				34.26	73.0
Berkeley	59	33	47.4	10.45	
Bishop	76	12	45.6	1.65	
Boca *1	50	2	30.8	5.20	52.0
Bodie	56	—13	26.4	6.13	51.5
Bowman				45.61	110.0
Branscomb	65	22	41.2	36.69	6.5
Brush Creek	60	25	42.6	23.11	T.
Butte Valley				22.90	125.0
Calabasas				5.66	
Caliente *1	78	39	53.4	2.45	
Campbell	67	30	49.8	3.38	
Campo				2.68	
Cedarville	55	3	33.5	4.87	18.5
Chico	66	28	48.8	5.64	
Chino	78	34	54.6	2.14	
Cisco *1	44	11	31.5	30.80	131.0
Claremont	81	33	54.4	2.87	
Cloverdale	65	31	48.2	16.34	
Colusa	67	29	48.7	3.13	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Corning *5	75	32	51.2	4.95	
Coronado				1.63	
Crescent City	56	33	45.3	24.84	
Cuyamaca	65	9	40.3	3.76	5.0
Delano *1	76	29	52.6	2.01	
Delta *1	69	22	43.2	21.19	7.0
Dobbins	75	34	50.1	14.04	
Drytown	62	30	48.6	11.21	
Dunnigan *1	65	31	49.5	5.33	
Durham	70	30	48.8	5.75	
Elcajon	83	30	54.7	2.19	
Electra				13.92	
Elmdale	74	27[c]	52.0	2.19	
Elsinore	88	24	53.7	1.49	
Escondido	77	22	49.8	2.66	
Fallbrook	78	31	53.1	2.94	
Folsom City				7.19	
Fort Bragg				15.15	
Fort Ross	62	33	48.0	21.62	
Foster				3.05	
Fouts Springs				9.44	
Georgetown	63	23	42.7	26.02	
Gilroy (near)	73	29	50.5	4.34	
Greenville	54	8	36.0	18.81	30.0
Hanford	77	28	49.4	2.03	
Healdsburg	65	28	48.2	17.60	
Highland Springs				17.55	T.
Hollister	69	28	51.0	3.30	
Idylwild	73	16	43.6	2.70	7.0
Imperial	93	30	61.5	0.05	
Iowa Hill *1	63	32	44.4	20.20	5.5
Irvine				2.01	
Isabella	80	29	54.6	3.06	
Jamestown	63	26	47.6	12.96	
Jolon				4.65	
Kennedy Gold Mine				13.79	
Kentfield				21.72	
King City	80	25	53.0	2.47	
Lakeport (near)	57	34	45.1	8.78	T.
Lamesa				2.20	
Laporte	53	12	33.2	30.35	95.6
Legrande	70	28	49.1	2.60	
Lemoncove	78	28	53.8	4.58	
Lick Observatory	61	22	39.6	9.53	3.5
Livermore	65	29	50.1	4.18	
Lodi	64	28	49.4	5.77	
Lordsburg				3.57	
Los Gatos	67	34	48.6	9.14	
Magnolia	74	24	43.7	23.39	0.5
Mammoth	90	30	61.7	0.00	
Marysville	63	29	49.4	5.18	
Merced	74	24	52.9	2.30	
Mercury				23.51	
Mills College				9.96	
Milo				5.88	
Milton (near)	62	33	50.2	6.78	
Modesto *1	75	34	53.5	1.67	
Mohave	80	28	53.0	0.76	
Mokelumne Hill				13.35	
Montague	58	17	38.4	5.13	T.
Monterio	76	30	49.4	3.39	
Monterey *1	61	32	50.2	2.77	
Mount St. Helena				28.34	3.0
Napa	56	31	44.9	8.23	
Needles	90	40	63.2	0.10	
Nellie				6.77	7.0
Nevada City	69	22	42.4	19.17	10.0
Newcastle	68	33	49.1	10.79	
Newman	71	27	51.0	1.51	
Niles	64	34	50.3	5.56	
Nimshew	63	26	42.6	17.95	T.
Nordhoff				4.24	
North Bloomfield	65	12	40.4	16.44	8.0
Oakland	63	35	50.6	9.45	
Ontario (near)	82	33	54.9	1.96	
Orland	76	30	49.9	4.06	
Orleans	66	33	46.6	24.27	
Oroville (near)	64	32	49.2	7.99	
Palermo	66	31	47.6	7.22	
Peachland *5	59	30	49.0	17.01	
Pilot Creek				29.68	45.0
Pine Crest	74	38	54.9	5.65	
Pino Grande	59	21	38.2	28.16	44.2
Placerville	62	26	45.8	15.59	
Point Lobos	59	39	50.1	4.59	
Porterville	80	29	54.1	3.48	
Poway				2.95	
Priest Valley				5.26	
Quincy	57	14	37.2	22.10	19.0
Redding	71	30	46.7	14.10	T.
Redlands	88	32	56.2	1.50	
Reedley	74	31	54.6	3.39	
Represa	62	34	50.0	8.33	
Riovista	64	30	48.9	6.68	
Riverside	84	29	54.0	1.21	
Rohnerville				15.30	
Rosewood	70	21	44.4	7.38	
Sacramento	64	31	49.8	6.15	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Salinas	70	30	52.4	2.66	
Saltou	90	30	58.0	0.00	
San Bernardino	87	28	55.2	2.21	
San Jose	73	34	53.4	3.01	
San Leandro	64	30	49.2	9.46	
San Mateo*1	66	35	53.6	6.97	
San Miguel*1	70	28	50.8	1.74	
San Miguel Island				3.45	
San Rafael	62	30	48.6	15.38	
Santa Barbara	73	37	54.6	4.69	
Santa Clara College	69	30	50.8	3.47	
Santa Cruz	67	30	49.8	5.45	
Santa Maria	73	34	54.4	5 39	
Santa Monica	72	38	54.0	3.12	
Santa Rosa	60	27	47.4	12.23	
Sausalito				9.27	
Shasta	73	30	45.5	24.86	
Sierra Madre	77	39	55.2	4.92	
Sisson	58	8	40.2	10.91	24.5
Snedden				1.55	
Sonoma				9.08	
Sonora	60	28	45.9	13.82	2.8
Stirling City	71	16	38.4	26.51	14.5
Stockton	60	30	48.6	4.09	
Storey	70	20	46.8	2.69	
Summerdale	60	16	38.6	14.96	44.0
Summit	48	18	30.6	30.40	172.0
Susanville	51	5	33.8	9.05	20.0
Tehama*1	67	34	51.8	4.67	
Tejon Ranch	78	38	55.2	2.89	
Truckee*1	50	10	32.8	16.41	96.0
Tulare c	80	28	53.8	2.55	
Tustin				1.47	
Ukiah	66	25	46.8	17.29	
Upland	76	33	52.8	4.26	
Upperlake	69	20	43.5	11.19	
Upper Mattole				31.46	
Vacaville*1	65	30	49.5	8.61	
Ventura	75	38	54.8	4.54	
Visalia	78	28	53.4	2.54	
Volcano	93	26	59.6	0.00	
Wasco	80	26	53.8	1.93	
Westpoint				16.36	26.0
Wheatland	64	30	48.1	6.14	
Willits				26.56	T.
Willow	64	28	48.0	3.44	
Yosemite				13.95	25.5
Zenia	62	15	38.8	27.58	21.0
Colorado.					
Alford	64	3	34.2	0.28	3.5
Antelope Springs	55	−16	25.7	0.18	2.5
Ashcroft	49	−15	23.6	1.24	18.5
Blaine	90	− 3	38.3	0.00	
Boulder	73	10	41.4	0.31	3.0
Breckenridge	52	−18	25.4	2.81	39.5
Buenavista				0.13	2.0
Burlington	77	− 6	33.9	T.	T.
Canyon	76	1	39.2	0.25	5.0
Castlerock	72	− 3	37.4	0.48	4.6
Cheesman	65	− 2	38.3	0.30	3.8
Cheyenne Wells	77	− 4	34.6	T.	T.
Clearview	54	−11	29.3	0.52	8.5
Collbran	62	−15	32.6	0.95	12.5
Colorado Springs	71	− 1	36.9	0.02	0.8
Conejos e	64	0	31.1	0.00	
Cripplecreek				0.40	6.9
Durango	69	4	36.8	0.31	2.9
Fort Collins	69	3	35.3	0.34	2.5
Fort Morgan	82	4	35.2	0.58	2.8
Fowler				0.20	1.8
Fox	75	− 2	33.6	T.	0.8
Fruita	69	−14	33.4	0.91	5.0
Garnett	64	−11	27.6	0.15	2.0
Gilman				1.77	22.8
Gleneyre	74	0	35.3	0.11	1.8
Greeley	73	2	35.8	0.20	3.0
Grover				0.10	2.0
Gunnison	61	−19	25.6	0.38	4.2
Halls Gulch		− 9		1.53	23.8
Hamps	72i	− 6	34.2e	0.07	1.8
Hoehne	75	− 1	39.0	0.30	3.0
Holly	82	3	37.1	T.	T.
Holyoke (near)	74	−10	30.8	0.17	2.5
Husted	70	− 9	33.6	0.10	1.4
Lake Moraine	48	4	29.3	0.41	5.8
Lamar	82	5	40.0	0.00	
Laporte				0.23	3.0
Las Animas	81	0	37.4	0.00	
Lay		−32		0.44	6.5
Leadville (near)	46	− 7	24.4	1.19	11.5
Leroy	70	− 2	33.2	0.26	3.0
Longs Peak	48	−13	27.2	0.85	13.0
Mancos	66	2	35.4	0.91	2.8
Marshall Pass				1.22	25.0
Meeker	60	−25	30.9	0.86	8.7
Montrose	72e	1e	35.2e	0.38	3.0
Moraine	51	− 6	29.4	1.33	17.9
Pagoda	57	−13	29.1	1.26	15.0
Parachute	65	− 8	33.9	1.33	10.9
Platte Canon				0.38	3.8
Rangely	65	−11	31.5	0.26	1.2
Rockyford	81	5	38.5	T.	T.
Ruby				5.73	74.0
Saguache	68	− 4	30.8	0.03	0.5
Salida	67	− 4	37.8	0.36	3.0
San Luis	65	−10	32.9	0.10	2.0
Santa Clara	66	8	36.1	0.36	5.0
Silt	64	− 2	33.8	1.04	5.0
Sugar Loaf				0.26	4.0
Trinidad	72	12	43.0	0.28	3.0
Vilas				0.00	
Wagon Wheel	61	−15	26.7	0.30	3.5
Walden	51	−21	26.5	0.16	3.0
Wallet				0.00	
Waterdale	71	− 1	37.2	0.28	2.3
Westcliffe	61	−11	33.3	0.43	5.0
Whitepine	48	−12	20.4	2.02	21.8
Wray	75	− 5	33.8	0.58	2.0
Yuma				0.70	4.0
Connecticut.					
Bridgeport	48	0	23.4	2.90	6.3
Canton	53	−12	17.8	2.17	7.0
Colchester	51	− 3	21.8	3.67	9.0
Falls Village				2.29	6.2
Hartford	48	0	21.2	2.53	6.0
Hawleyville	50	− 6	20.0	3.34	9.0
Lake Konomoc				3.69	
New London	48	0	22.2	2.93	9.5
North Grosvenor Dale	49	− 9	18.9	2.89	
Norwalk	47	− 3	21.6	3.05	7.0
Southington	52	− 4	21.4	2.65	6.5
South Manchester				2.54	5.0
Storrs	49	− 4	18.6	2.80	9.4
Voluntown	50	− 6	23.1	3.64	8.0
Waterbury	49	− 4	21.2	2.54	6.0
West Cornwall	48	− 7	16.6	3.13	17.0
West Simsbury				1.88	7.0
Delaware.					
Delaware City				1.98	4.8
Milford	64	4	29.7	2.10	3.8
Millsboro	65	− 1	29.9	2.61	6.0
Newark	56	− 1	25.0		
Seaford	59	3	28.5	2.32	5.5
District of Columbia.					
Distributing Reservoir*5	58	5	28.2	0.89	
Receiving Reservoir*5	58	4	27.2	0.83	
West Washington	59	2	28.5	1.91	2.0
Florida.					
Apalachicola	74	36	57.0	1.84	
Archer	83	27	58.6	4.22	
Avon Park	87	35	65.4	2.73	
Bartow	85	31	64.8	4.99	
Bonifay	80	28	56.8	4.10	
Brooksville	85	34	62.6	1.50	
Carrabelle	77	30	57.1	2.84	
Clermont	85	36	64.8	2.97	
De Funiak Springs	80	24	56.0	2.95	
Deland	82	29	60.4		
Eustis	87	33	64.0	2.35	
Federal Point	82	30	58.7	6.00	
Fernandino	80	31	54.9	6.33	
Flamingo	88	51	70.0	T.	
Fort Meade	87	30	64.5	6.91	
Fort Pierce	84	40	65.6	1.81	
Gainesville	83	31	59.8	2.83	
Huntington	84	28	58.8	3.44	
Hypoluxo	85	45	68.7	3.66	
Inverness	89	28	61.3	1.43	
Jasper	82	27	55.6	2.35	
Johnstown	82	28	56.4	2.34	
Kissimmee	82	37	63.0	5.16	
Lake City	83	28	57.9	2.26	
Macclenny	84	27	57.4	2.51	
Madison	83	29	57.2	3.83	
Malabar	85	37	63.8	3.77	
Manatee	84	37	64.0	2.44	
Marco	85	43	68.1	0.22	
Merritt Island	80	41	64.2	4.02	
Miami	85	44	70.8	1.65	
Micanopy	85e	29e	60.1e	5.00	
Middleburg	82	23	55.6	3.44	
Molino	83	27	57.2	4.20	
Monticello	83	30	58.2	3.10	
Myers	83	38	65.2	2.00	
New Smyrna	84	31	60.2	4.15	
Nocatee	88	39	66.5	1.03	
Ocala	87	28	61.4	2.03	
Orange City	89	27	62.4	2.51	
Orange Home	85	30	61.8	3.72	
Orlando	89	33	64.1	2.45	
Pinemount	82	26	55.8	3.37	
Rockwell	83	35	60.2	1.87	
St. Andrews	76	29	55.9	2.83	
St. Augustine	85	29	57.2	4.86	
St. Leo	84	30	62.5	1.96	
Stephensville	81	25	56.4	4.02	
Sumner	87	24	57.7	3.73	
Switzerland	82	28	57.0	3.96	
Tallahassee	77	31	56.5	2.75	
Tarpon Springs	84	32	62.0	2.06	
Wausau				3.50	
Wewahitchka	84	30	56.8	3.17	
Georgia.					
Abbeville				5.38	
Adairsville	73	23	43.6	4.31	
Albany	81	28	50.3	4.99	
Allapaha	80	25	51.7	2.84	
Alpharetta	72	17	41.8	4.29	
Americus	73	28	48.8	9.60	
Athens	72	24	42.1	5.15	
Blakely	81	26	53.7	2.90	
Bowersville	72	24	42.4	2.75	
Butler				4.58	
Camak	77	22	45.9	2.57	
Canton				4.34	
Carlton				5.82	
Clayton	70	10	40.5	5.47	
Columbus	77f	27f	51.0b	5.08	
Cordele	78	24	49.9	5.17	
Covington	76	23	45.9	4.16	
Dahlonega	69	14	40.7	4.43	T.
Dawson	78	24	52.4	4.01	
Diamond	69	5	39.4	5.91	T.
Dublin				4.01	
Dudley	77	23	49.4	3.81	
Eatonton	73	24	46.1	4.13	
Elberton	71	21	43.5	5.54	
Experiment	72	25	44.6	3.24	
Fitzgerald	83d	22	51.2	2.69	
Fleming	83	23	54.4	3.08	
Gainesville	70	22	40.8	1.96	
Gillsville	72	19	43.1	3.00	
Greenbush	75	17	43.7	1.64	
Greensboro	74	22	43.6	3.61	
Griffin	74f	25b	46.5d	3.69	
Harrison	75	23	48.6	4.92	
Hawkinsville	78d	21	47.2	5.88	
Jesup	82	24	52.6	2.73	
Lost Mountain	75	23	43.2	3.28	
Louisville	75	22	47.0	3.76	
Lumpkin	79l	30l	53.8l	7.85	
Marshallville	75	29	49.8	5.46	
Mauzy	80	24	55.0	2.86	
Milledgeville	74	22	45.4	3.63	
Millen	82			2.98	
Monticello	73	25	45.2	3.58	
Morgan	79e	26	52.0	4.32	
Newnan	73	20	42.9	4.67	
Oakdale				4.26	
Oakfield				4.40	
Point Peter	74	19	43.2	5.96	
Poulan	82	22	51.0	3.17	
Putnam	77	26	49.8	6.59	
Quitman	79	27	54.0	3.09	
Ramsey	71	20	43.2	2.89	T.
Resaca				2.84	T.
Rome	76	23	44.0	3.57	
St. Marys	82	25	53.8	4.04	
Statesboro	80	26	50.8	4.75	
Talbotton	74	25	48.6	5.08	
Tallapoosa				2.93	
Thomasville	79	27	55.4	3.11	
Toccoa	73	19	42.5	4.14	
Valona	78	28	52.6	1.78	
Washington	73	22	42.8	5.15	T.
Waverly	84	24	54.1	2.58	
Waycross	80	27	52.6	1.84	
Westpoint	79	23	46.3	5.09	
Woodbury	79	21	45.0	5.30	
Idaho.					
Albion	59	2	34.4	2.20	12.0
American Falls	54	7	30.1	2.70	
Blackfoot	53	− 4	27.4	2.35	1.0
Blue Lakes	66	9	38.3	2.18	3.2
Burnside	48	− 4	22.3	2.10	21.0
Cambridge	49e	− 5e	27.8e	5.25	
Chesterfield	49	−21	25.5	2.63	6.0
Forney	58	−11	27.2	3.83	32.0
Garnet	73	15	40.8	1.05	1.0
Grangeville	54	8	32.2	5.58	54.3
Lake	44	− 8	23.0	2.70	27.0
Lakeview	46	12	33.2	4.81	23.0
Lost River	47	−17	20.4	1.75	20.0
Meadows	49	− 5	26.2	4.28	23.0
Milner	64	4	35.8	1.65	4.5
Moscow	51	11	31.4	1.50	13.6
Murray	50	1	30.6	4.49	56.0
Oakley	60	9	34.0	0.95	3.5
Ola	54	− 8	31.9	4.94	19.5
Orofino	50	14	35.0	4.35	23.5
Paris	48	−31	18.4		
Payette	60	14	35.4	3.45	14.0
Pollock		23		3.54	8.0
Porthill	44	5	30.2	2.80	42.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
Priest River	42[j]	16[j]	31.6[j]	3.84	.....
Riddle	.....	.....	.....	2.60	16.5
St. Maries	50	12	33.5	2.91	19.2
Soldier	43	—15	20.2	8.33	72.0
Vernon	46	— 7	22.2	1.85	18.5
Weston	55[d]	—12[e]	28.0[d]	2.73	12.0
Illinois.					
Albion	68	— 4	30.0	2.71	.....
Aledo	63	—12	18.7	0.37	3.7
Alexander	65	—11	23.8	1.40	3.0
Antioch	44	—14	12.4	1.10	11.0
Ashton	53	—13	15.3	2.09	16.0
Astoria	61	—14	21.3	1.07	7.5
Aurora	53	—12	16.3	1.47	11.4
Benton	70	— 1	32.6	3.34	.....
Bloomington	60	—12	22.0	1.35	4.5
Bushnell	66	—15	21.4	0.40	4.0
Cambridge	59	—10	17.1	1.00	9.0
Carlinville	65	— 7	26.3	1.09	6.0
Carrollton	64	— 5	24.4	0.24	2.8
Charleston	58	- 11	24.8	1.20	1.7
Chester	.....	.....	.....	2.02	0.1
Cisne	69	— 5	30.6	2.15	.....
Coatsburg	64	—14	22.4	1.20	2.0
Cobden	71	2	33.9	2.90	1.5
Danville	58	— 8	23.4	1.95	3.8
Decatur	62	—11	23.8	1.33	4.5
Dixon	.....	.....	.....	0.79	10.7
Equality	71	4	33.5	3.49	2.0
Fandon	65	—15	21.6	0.99	5.0
Flora	66	—12	27.8	2.00	0.2
Friendgrove	65	— 4	29.0	2.63	T.
Galva	60	—12	17.6	0.89	7.7
Grafton	.....	.....	.....	0.43	3.0
Greenville	64	— 7	27.8	1.10	1.0
Griggsville	69	— 8	25.9	1.60	.....
Halfway	69	0	32.3	3.94	1.0
Havana	63	—10	22.8	1.46	5.0
Henry	58	—12	19.6	1.43	13.0
Hillsboro	63	— 9	26.6	0.90	2.0
Hoopeston	.....	.....	.....	2.16	17.5
Joliet	50	— 5	17.2	1.75	14.4
Kishwaukee	52	—13	14.1	1.30	9.0
Knoxville	62	—19	18.4	0.74	5.2
Lagrange	52	— 8	16.6	1.56	16.5
Laharpe	65	—16	20.4	0.90	1.5
Loami	.....	.....	.....	1.35	4.8
McLeansboro	69	— 4	31.1	3.49	1.0
Martinsville	62[e]	—10[e]	26.0[e]	0.55	0.5
Martinton	60	— 9	20.1	1.60	10.0
Mascoutah	67	— 3	28.5	1.71	1.3
Mattoon	.....	.....	.....	1.26	T.
Minonk	59	—16	18.9	1.48	6.5
Monmouth	61	—15	18.6	0.80	3.7
Morrison	57	—15	16.8	1.13	10.8
Morrisonville	61	—11	24.8	1.14	4.6
Mount Carmel	.....	.....	.....	3.50	3.6
Mount Pulaski	60	—12	22.4	1.00	6.0
Mount Vernon	69	0	30.3	2.58	0.5
New Burnside	72	— 1	32.6	2.92	4.0
Olney	64	— 5	28.9	2.05	0.2
Ottawa	57	— 7	20.4	1.80	18.2
Palestine	64	—10	27.7	2.30	.....
Pana	61	—10	25.0	1.19	2.0
Paris	59	— 9	22.8	.....	.....
Peoria a	.....	.....	.....	1.01	.....
Peoria b	59	— 8	23.0	1.29	10.0
Philo	59	—16	22.2	1.25	1.1
Plumhill	69	— 5	31.1	1.41	T.
Pontiac	59	—11	20.4	1.84	12.0
Rantoul	59	—13	21.0	1.38	9.0
Raum	72	2	32.6	2.67	1.6
Riley	45	—14	13.8	1.43	12.0
Robinson	64	— 9	27.8	2.24	0.3
Rushville	62	—11	23.0	0.69	6.0
St. Charles	50	— 9	16.0	2.07	18.5
St. John	69	3	31.6	2.84	2.0
Shobonier	63	— 8	29.3	0.25	T.
Streator	60	—10	19.6	1.55	13.8
Sullivan	62	—10	24.2	1.71	.....
Sycamore	52	—12	12.4	1.52	13.7
Tilden	68	— 3	30.9	1.83	T.
Tiskilwa	56	—10	17.1	1.17	9.9
Tuscola	60	—11	21.6	1.21	5.0
Urbana	60	—11	21.7	1.86	4.0
Walnut	58	— 9	18.6	1.55	11.4
Winchester	64	— 5	24.6	1.66	6.0
Windsor	62	—12	24.9	0.91	1.7
Winnebago	52	—14	13.8	1.38	14.0
Yorkville	52	—12	16.1	1.74	13.1
Zion	54	—11	12.8	0.60	6.0
Indiana.					
Anderson	63	— 9	22.6	2.12	6.1
Angola	44	—12	15.5	4.77	7.6
Auburn	50	—10	18.0	3.75	.....
Bloomington	65	— 3	28.0	4.05	4.0
Bluffton	54	—12	21.2	2.06	6.0
Butlerville	65	— 2	29.0	2.69	1.9
Indiana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Cambridge City	64	—10	23.8	2.25	2.8
Columbus	69	—10	27.8	2.21	1.7
Connersville	68	— 7	25.2	2.88	3.7
Crawfordsville	59[c]	— 9	22.8	0.98	6.0
Delphi	54	—10	19.0	1.61	5.8
Elkhart	50	— 6	17.0	3.31	11.8
Farmersburg	60	—14	26.2	0.90	.....
Farmland	61	— 5	23.5	2.69	6.5
Fort Wayne	52	—10	19.6	2.85	5.0
Franklin *1	61	— 7	28.0	2.35	1.8
Greencastle	60	— 6	24.2	1.81	4.4
Greenfield	66	— 5	24.2	3.58	3.0
Greensburg	65	— 6	27.0	2.35	.....
Hammond	51	— 8	17.0	2.83	16.0
Hector	56	—11	20.8	2.50	.....
Holland	68	1	31.8	3.55	.....
Huntington	50	— 8	19.2	2.64	6.0
Jeffersonville	68	9	32.6	3.25	3.0
Kokomo	56	— 8	22.2	1.51	5.5
Lafayette	56	—10	20.0	1.83	9.0
Laporte	47	— 5	18.2	3.24	7.0
Logansport	55	— 8	19.4	1.74	14.0
Madison a	68	3	31.7	3.52	4.7
Marengo	69	6	32.0	3.24	2.0
Marion	53	— 9	21.2	2.44	8.5
Markle	54	—11	20.4	2.21	4.0
Mauzy	65	—11	24.2	2.48	4.8
Moores Hill	64	— 4	27.5	2.55	1.8
Mount Vernon	57	4	28.2	1.25	.....
Northfield	56	—18	21.5	2.66	19.0
Paoli	69	— 3	30.3	2.01	2.5
Princeton	67	— 1	29.6	3.14	2.0
Rensselaer	52	—10	19.5	2.33	9.0
Richmond	66	—11	24.6	2.39	2.3
Rockville	59	—12	24.3	0.92	3.0
Rome	74	4	32.5	4.37	2.8
Salem	68	— 1	31.0	2.77	4.2
Scottsburg	68	6	31.8	2.25	3.5
Seymour	67	1	29.0	2.65	5.5
Shelbyville	61	— 5	25.6	2.26	1.0
South Bend	46	—10	14.6	2.40	12.0
Syracuse	51	—10	18.2	3.70	6.0
Terre Haute	63	— 4	28.6	1.32	3.5
Topeka	45	—15	16.0	.....	.....
Valparaiso	50	—10	18.6	1.70	.....
Veedersburg	58[d]	—14[d]	23.2[d]	0.92	1.5
Vevay	67	3	31.3	3.35	2.0
Vincennes	66	— 1	31.5	2.26	0.2
Washington	67	— 5	28.8	3.09	0.5
Worthington	80	—11	27.2	3.42	.....
Indian Territory.					
Ardmore	86	18	46.0	0.40	2.4
Chickasha	92	13	46.2	T.	T.
Claremore	85[c]	16[c]	44.4[c]	T.	T.
Durant	81	21	45.9	1.69	1.9
Fairland	80	14	42.2	0.56	T.
Goodwater	82	18	48.6	4.69	.....
Hartshorne	81	20	46.8	0.48	1.0
Healdton	89	17	48.8	0.58	3.0
Holdenville	84	18	44.9	T.	T.
Marlow	94	11	44.7	0.15	1.0
Muskogee	80	16	40.6	0.08	T.
Okmulgee	82	12	44.6	0.03	0.3
Pauls Valley	89	15	46.4	0.20	1.0
Ravia	83	20	48.4	0.50	1.5
Roff	84	13	45.4	0.40	.....
South McAlester	79	19	46.6	0.96	1.5
Tulsa	.....	.....	.....	0.00	.....
Vinita	82	15	41.6	0.56	2.1
Wagoner	82	12	44.2	0.15	1.0
Webbers Falls	82	18	44.6	0.40	0.5
Iowa.					
Afton	47	—10	18.7	0.15	1.5
Albia	63	—12	16.2	0.26	3.0
Algona	42	—19	9.2	0.28	6.5
Allerton	62	—16	19.8	0.26	2.3
Alta	53	—15	11.6	0.76	7.5
Amana	53	—11	16.4	0.70	6.2
Ames	47	—13	14.9	0.40	3.5
Atlantic	49	—12	17.9	1.19	1.5
Audubon	47	—16	14.5	0.15	1.5
Baxter	49	—10	15.4	0.34	0.9
Bedford	51	—11	20.2	0.22	0.5
Belknap	60	—11	19.0	0.50	4.0
Belleplaine	46	—15	14.2	1.26	12.5
Bonaparte	63	—18	18.8	0.23	2.0
Britt	43	—22	10.2	0.55	4.4
Buckingham	.....	.....	.....	0.47	4.4
Burlington	65	—13	21.0	0.34	.....
Carroll	50	—14	14.6	0.70	7.0
Cedar Rapids	54	—12	14.2	0.11	.....
Chariton	61	— 6	19.2	0.02	0.2
Charles City	41	—24	8.2	0.57	3.4
Clarinda	67	— 6	19.3	0.14	T.
Clearlake	40	—21	9.8	0.60	6.0
Clinton	57	—10	16.2	0.95	7.0
College Springs	49	— 2	20.7	.....	.....
Columbus Junction	61	—11	19.0	0.54	3.4
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Corning	49	—12	18.6	0.08	0.5
Corydon	63	—17	18.4	0.12	0.5
Cresco	40	—22	11.2	.....	.....
Cumberland	.....	.....	.....	0.10	1.0
Decorah	43	—23	10.7	0.48	5.0
Delaware	47	—20	11.6	0.49	4.3
Denison	57	—12	16.8	0.30	3.0
Desoto	47	—11[c]	17.6[d]	0.25	2.5
Dows	42	—21	10.8	0.75	7.5
Earlham	46	—14	15.2	0.37	2.0
Elkader	47	—22	12.0	0.65	7.2
Estherville	40	—20	7.2	0.39	.....
Fayette	49	—26	10.8	1.02	5.6
Forest City	40	—19	7.4	0.70	7.0
Fort Dodge	47	—17	13.0	0.60	6.0
Fort Madison	.....	.....	.....	0.35	3.5
Galva	54	—18	12.6	0.50	.....
Gilman	.....	.....	.....	0.55	5.0
Glenwood	57	— 4	20.0	0.02	0.2
Grand Meadow	45	—20	11.4	0.83	7.5
Greenfield	45	—10	16.8	0.20	2.0
Grinnell	49	—10	15.3	0.73	2.3
Grundy Center	48	—23	13.0	0.58	5.5
Guthrie Center	60	—15	18.4	0.30	.....
Hampton	44	—19	11.9	0.95	9.1
Hanlontown	39	—24	8.4	0.53	5.2
Harlan	51	— 8	17.0	0.17	1.7
Hopeville	52	—12	18.3	0.04	.....
Humboldt	45	—21	13.6	0.50	5.0
Ida Grove	50	—15	13.7	0.30	3.0
Indianola	48	—11	17.2	0.61	3.5
Inwood	48	—17	11.0	0.30	3.0
Iowa City	63	—14	13.8	0.84	8.0
Iowa Falls	43	—23	10.7	1.03	9.8
Jefferson	.....	.....	.....	0.83	5.9
Keosauqua	70	—16	17.3	0.52	3.5
Knoxville	56	—10	18.1	0.45	3.0
Lacona	.....	.....	.....	0.63	4.5
Larrabee	56	—17	11.9	0.46	4.6
Leclaire	.....	.....	.....	0.68	6.0
Lemars	54	—15	13.6	0.80	8.0
Lenox	45	— 7	18.4	0.09	0.8
Leon	55	— 3	20.0	0.05	0.5
Logan	58	— 8	19.0	0.50	5.0
Maple Valley	.....	.....	.....	0.55	5.0
Maquoketa	59	—14	12.1	0.74	6.5
Marshalltown	50	—17	13.1	0.50	5.0
Mason City	38	—14	11.5	0.77	7.7
Monticello	55	—16	13.6	0.95	10.0
Mountayr	50	— 7	20.2	0.24	1.0
Mount Pleasant	61	—14	19.4	0.37	2.8
Mount Vernon	59	—14	15.2	0.80	8.2
New Hampton	41	—23	9.9	0.70	6.0
Newton	47	—15	15.4	0.74	9.5
Northwood	46	—19	10.8	0.88	8.0
Odebolt	53	—12	15.1	0.56	5.2
Ogden	47	—22	11.5	0.26	5.8
Olin	57	—14	15.2	1.18	5.2
Onawa	58	— 7	19.0	0.29	2.5
Osage	38	—20	10.0	0.66	6.2
Osceola	55	— 9	20.8	.....	.....
Oskaloosa	60	—15	16.8	0.19	2.3
Ottumwa	66	— 8	19.6	0.25	2.6
Pacific Junction	58	— 5	19.5	0.07	0.4
Perry	46	—13	15.4	0.55	5.5
Plover	44	—18	10.0	0.66	6.0
Primghar	52	—17	11.3	.....	.....
Redoak	47	— 1	21.2	0.05	0.5
Ridgeway	46	—20	13.0	1.99	10.6
Rock Rapids	49	—15	12.0	0.65	4.0
Rockwell City	47	—14	13.5	0.45	4.5
Sac City	49	—12	13.7	0.57	5.7
St. Charles	49	— 8	18.1	0.33	4.2
Sheldon	54	—18	12.6	0.31	3.1
Sibley	55	—19	8.6	0.46	3.5
Sigourney	57	—14	18.4	0.29	3.0
Sioux Center	51	—17	11.7	0.28	2.5
Spirit Lake	45	—20	11.2	0.55	5.5
Stockport	.....	.....	.....	0.44	3.0
Storm Lake	53	—16	11.9	0.08	0.9
Thurman	54	— 8	20.0	T.	T.
Tipton	59	—10	16.4	0.89	7.2
Toledo	52	—18	14.4	0.53	9.5
Villisca	46	— 3	21.3	0.26	2.0
Vinton	.....	.....	.....	0.64	5.6
Wapello	59	— 5	18.8	0.19	1.2
Washington	62	—16	13.7	0.53	3.0
Washta	.....	.....	.....	0.40	4.0
Waterloo	49	—18	14.0	0.48	5.0
Waukee	50	— 7	17.6	0.36	3.5
Waverly	43	—22	11.4	0.78	5.5
Westbend	46	—19	11.0	0.72	7.0
Whitten	46	—22	12.6	0.60	6.0
Wilton Junction	60	—13	17.4	0.50	6.0
Winterset	45	— 7	18.3	.....	.....
Woodburn	.....	.....	.....	0.22	2.2
Kansas.					
Achilles	76	— 6	30.4	0.02	0.2

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Alton	71	— 2	30.0	T.	
Anthony				0.00	
Atchison	70	4	27.4	1.55	0.5
Baker	67	1	23.6	0.25	1.0
Beloit	69	— 1	28.8	T.	T.
Burlington	73	5	35.0	0.11	0.5
Chanute	77c	10c	37.6c	T.	T.
Chapman	72	5	31.6	0.05	T.
Clay Center	67	— 1	28.8	0.16	T.
Coffeyville	85	12	40.0	T.	T.
Colby	77	— 4	32.1	0.00	
Columbus	80	13	38.2	0.44	1.0
Cunningham	87	3	35.8	T.	
Dresden	73	— 1	31.7	0.00	
Eldorado	78	— 5	36.0	0.03	0.3
Ellinwood	76	1	33.9	0.01	T.
Emporia	72	5	34.4	0.09	T.
Englewood	87	1	38.6	T.	
Enterprise	70	2	30.9	0.04	T.
Eureka				0.14	1.0
Eureka Ranch	78	— 3	31.4	T.	T.
Fall River	78	9	36.8	0.07	T.
Farnsworth	81	0	34.6	T.	T.
Forsha	76	2	32.6	T.	
Fort Leavenworth	69	6	29.8	0.22	2.0
Fort Scott	80	10	36.8	0.57	0.8
Frankfort	65	— 2	27.4	0.05	0.5
Garden City	84	1	36.4	T.	T.
Gove*1	72	3	30.6	0.00	
Grenola	80	5	35.2	0.05	0.5
Hanover	65	1	28.6	0.02	0.2
Harrison	68	— 6	26.2	T.	T.
Hays	74	— 1	29.2	0.06	T.
Holton	68	1	27.0	0.14	1.0
Horton	68	2	26.2	0.15	0.5
Hoxie	73	0	32.1	T.	T.
Hutchinson	81	1	31.8	0.10	T.
Independence	78	11	39.4	0.16	0.1
Jetmore	85	1	32.6	T.	T.
La Crosse	81	1	32.8	T.	T.
Lakin	82	— 2	36.4	T.	T.
Lawrence	69	6	30.0	0.22	0.5
Lebanon	67	— 5	28.7	T.	T.
Lebo	69	4	31.4	0.09	0.3
Macksville	80	3	36.2	T.	T.
McPherson	78	2	31.0	0.07	T.
Madison	73	5	33.5	0.16	0.2
Manhattan b	73	1	30.1	0.10	T.
Manhattan c	74	2	28.5	0.01	T.
Marion	71c	3c	31.6c	T.	
Medicine Lodge	91	7	40.2	T.	
Minneapolis	70	— 1	30.1	T.	T.
Moran	77	8	35.4	0.19	T.
Mounthope	76	7	35.8	0.00	
Ness City	72	1	34.4	T.	
Newton	77	1	33.6	T.	T.
Norton	73c	— 2c	26.6c	T.	T.
Norwich	79	5	37.5	T.	T.
Oberlin				0.00	
Olathe	63	5	31.6	0.45	2.0
Osborne				0.06	T.
Oswego	84	11	39.6	0.20	1.0
Ottawa	71	4	30.6	0.43	0.5
Paola a	71	6	31.3	0.30	0.5
Pleasanton	77	8	35.1	0.25	0.5
Pratt	82	3	36.1	T.	
Republic	68	— 3	27.4	T.	T.
Rome	81	10	39.7	0.11	T.
Salina	77	0	33.1	0.06	T.
Sedan	79	7	37.0	T.	T.
Toronto	78	4	34.6	0.95	0.8
Ulysses	84b	1c	36.6c	T.	
Valley Falls	70	2	27.6	0.25	0.6
Viroqua	85	— 3	38.8	T.	T.
Wakeeney				T.	T.
Wallace	81	— 7	34.3	T.	T.
Walnut	78	11	37.7	0.24	0.2
Wamego*1	71	2	28.8	T.	T.
Winfield	76	8	37.8	T.	T.
Yates Center	81c	5c	34.6c	0.08	T.
Kentucky.					
Alpha	72	16	41.6	1.39	3.0
Anchorage	67	3	31.6	2.59	3.0
Bardstown	71	6	36.2	2.97	1.0
Beattyville	75c	7	34.2c	2.18	5.0
Beaver Dam	73	9	34.8	2.50	2.6
Berea	70	2	35.2	1.63	2.5
Blandville	72	11	35.4	2.45	0.8
Bowling Green	72	9	37.2	2.61	2.0
Burnside	74	10	39.3	1.09	
Cadiz	75	13	38.0	1.53	3.5
Calhoun	71	9	34.8	2.07	2.0
Catlettsburg	73	5	33.6	2.24	3.0
Earlington	73	10	38.6	1.83	4.0
Edmonton	69	8	37.3	2.45	1.5
Falmouth				2.63	3.5
Fords Ferry	73	9	35.8	2.04	2.0
Frankfort	69	8	33.6	2.46	1.0
Kentucky—Cont'd.					
Franklin	75	14	38.7		
Greensburg	71	8	34.8	2.05	3.0
Highbridge	68	6	34.8	1.99	3.3
Hopkinsville	73	11	38.0	2.24	2.0
Irvington	69	7	33.8	3.03	2.0
Jackson	74	9	38.9	2.06	4.9
Leitchfield	69	8	33.8	2.34	2.0
Loretto	69	— 2	34.0	1.67	3.1
Manchester	74b	9c	37.2c	1.94	4.5
Marrowbone	74	11	41.0	1.40	1.5
Mayfield	73	13g	36.4d	2.09	1.5
Maysville	71	2	32.0	2.34	3.2
Middlesboro f	70	12	35.6		
Mount Sterling	70	6	31.2	2.79	6.2
Owensboro	70	8	33.1	3.08	2.5
Owenton	63	1	30.9	4.02	3.5
Paducah a				2.38	2.0
Paducah b	74	10	37.4	2.12	1.0
Princeton	73	12	37.2	1.62	1.0
St. John	68	5	34.2	3.13	1.5
Scott	65	0	29.0	2.94	1.4
Shelby City	68	5	34.0	1.97	3.7
Shelbyville	68	7	33.0	3.29	4.2
Taylorsville	69	6	33.8	2.81	1.0
Williamsburg	74	12	37.5	1.09	1.4
Williamstown	65	0	30.7	3.05	4.0
Louisiana.					
Abbeville	83	30	58.2	4.24	
Alexandria	85	23	55.6	2.59	
Amite	84	26	57.8	5.70	
Baton Rouge	83	32	58.5	3.22	
Burnside	82	30	59.6	2.34	
Calhoun	83c	21c	52.5c	2.11	
Cameron	73	29	56.2	0.73	
Caspiana	84	26	55.6	2.28	
Cheneyville	83	20	56.2	1.10	
Clinton	85	27	56.2	5.23	
Collinston	84	23	52.0	2.23	
Covington	84	29	58.0	4.30	
Donaldsonville	85	29	60.2	1.86	
Emilie	82	32	58.4	2.43	
Farmerville	81			2.90	
Franklin	89	29	60.1	1.20	
Grand Coteau	83	30	59.4	1.96	
Hammond	82	29	58.4	2.57	
Houma	84	27	60.4	0.93	
Jennings	83	29	58.5	0.99	
Lafayette	83	30	58.2	5.29	
Lakeside	80	32	58.8		
Lawrence	80b	35c	61.0c	0.53	
Leesville	86	22	56.8	3.33	
Libertyhill	85	23	54.8	3.70	
Logansport				4.15	
Melville	86	24	57.6	0.74	
Minden	81d	25d	52.8d	1.25	
Monroe	85	26	53.5	2.56	
New Iberia	81	31	59.8	3.22	
Opelousas	83	28	58.2	0.99	
Oxford	86c	24c	56.2c		
Plain Dealing	81	22	51.9	1.37	
Port Eads	76	36	59.0	0.79	
Rayne	83	27	58.2	1.82	
Reserve				1.50	
Robeline	89	23	54.2	3.42	
Ruston	83	25	54.0	3.25	
St. Francisville	86	24	56.2	2.50	
Schriever	85	28	59.8	1.62	
Southern University				1.58	
Sugar Experiment Station	78	34	59.8	1.60	
Sugartown	81	30	57.8	1.96	
Venice	86	30	59.2	0.78	
Maine.					
Bar Harbor	45	—12	15.8	4.05	21.5
Belfast	43	—16	15.2	1.84	11.0
Cornish	46	—12	15.9	2.14	14.5
Danforth				2.89	21.0
Fairfield	42	—19	11.7	1.65	12.5
Farmington	40	—21	11.5	0.72	12.0
Gardiner	49	—20	12.0	2.24	14.8
Houlton	45	—34	9.9	2.35	19.0
Jackman				1.48	11.9
Lewiston	44	—13	12.6	2.32	14.1
Madison	45	—16	16.6	1.71	18.5
Mayfield	38	—14	12.8	1.81	14.5
Millinocket	41	—29	10.2	1.89	9.5
North Bridgton	44	—20	14.7	2.46	19.0
Oquossoc	39	—26	7.8	1.08	7.0
Orono	43	—26	12.2	2.57	18.0
Patten	40	—34	8.2		
Rumford Falls	40	—20	11.3	1.41	12.5
South Lagrange	42	—26	11.3	1.50	11.0
The Forks				1.40	12.0
Thomaston	43	—12	13.4	2.20	
Vanburen	39	—43	5.2	2.19	14.0
Vanceboro	44	—34	11.2	1.10	12.0
Winslow	45	—17	16.0	1.51	15.0
Maryland.					
Annapolis	64	2	29.6	2.20	
Maryland—Cont'd.					
Bachmans Valley	56	— 6	23.8	3.42	3.5
Boettcherville	65	— 8	27.4	1.00	2.5
Boonsboro	60	— 1	26.4	1.11	3.2
Cambridge	60	3	28.7	3.16	4.8
Chase	61	2	28.6		
Cheltenham	62	— 2	27.1	2.01	0.8
Chestertown	59	3	26.1	2.24	4.8
Chewsville	58	—11	23.5	0.34	2.0
Clearspring	63	— 2	23.5	1.65	4.5
Coleman	59	1	26.8	2.04	5.2
Collegepark	62	— 6	25.8		
Colora				1.69	8.5
Cumberland				1.23	
Darlington	57	0	24.6	1.85	4.0
Deerpark	61	—13	23.2	1.90	7.0
Denton				0.87	2.5
Easton	58	2	29.0	1.79	2.8
Fallston	59	— 1	25.3	1.99	3.0
Frederick	58	— 5	27.2	1.32	1.0
Grantsville	62	—11	22.6	2.40	6.5
Greatfalls	61	— 3	27.0	1.34	
Greenspring Furnace	61	— 2	25.2	1.20	3.6
Hancock	67	— 5	26.6	0.44	2.1
Harney				1.80	2.8
Jewell	62	4	28.5	1.84	1.0
Johns Hopkins Hospital	55	5	27.7	1.90	3.8
Laurel	62	7	29.5		
McDonogh	60	1	29.6		
Mount St. Marys College	55	2	25.6	1.75	1.0
New Market	56	— 1	25.7	1.38	1.0
Oakland	70	—15	23.9	2.31	12.2
Pocomoke City	66	7	32.9		
Prince Fredericktown	62	2	28.8	2.22	2.2
Princess Anne	59	0	29.5	3.06	8.5
Sharpsburg	60	— 3	26.4	1.69	0.5
Solomons	61	7	29.7	1.92	5.8
Sudlersville	60c	2c	27.5c	2.80	2.5
Takoma Park	62	2	26.0	1.77	
Van Bibber	58	3	27.3	2.22	T.
Westernport	60	— 2	25.2	1.13	3.5
Woodstock	61	2	28.3	1.32	0.3
Massachusetts.					
Amherst	48	— 8	17.4	2.45	10.0
Bedford	45	— 9	18.8	2.36	12.0
Bluehill (summit)	47	— 6	19.2	3.72	20.7
Cambridge	47	— 3	20.8	2.76	
Chestnuthill	48	— 8	21.0	2.90	15.0
Concord	46	—20	16.9	2.16	12.1
East Templeton *1	44	— 6	18.0	2.12	11.0
Fall River	50	0	23.4	3.99	13.5
Fitchburg a *1	45	— 4	18.4	2.02	10.5
Fitchburg b	46	— 5	18.9	1.82	10.5
Framingham	48	— 5	20.2	3.00	17.5
Groton	41	—10	17.4	1.48	14.0
Hyannis				3.43	14.7
Jefferson				2.52	11.5
Lawrence	46	—13	17.8	2.66	17.5
Leominster				2.01	11.0
Lowell a	46	—13	19.2	2.48	
Lowell b	46	—10	18.9		
Ludlow Center	41	—14	14.2	2.65	11.0
Middleboro	50	— 7	22.3	4.13	14.5
Monson	49	—10	19.0	3.46	12.5
New Bedford	48	— 1	22.0	4.65	19.0
Pittsfield				2.07	8.5
Plymouth *1				3.61	
Princeton				2.30	13.0
Provincetown	45	2	26.0	4.48	13.0
Salem				3.08	23.0
Somerset *1	48	— 7	21.6	3.50	15.5
Sterling				2.20	7.4
Taunton	48	—12	21.6	2.65	12.0
Webster				2.59	9.0
Westboro	46	— 8	20.0	2.00	10.5
Weston	47	—14	19.0	2.98	14.6
Williamstown	48	— 5	16.0	0.94	3.2
Winchendon				1.70	10.0
Worcester	48	— 4	19.6	1.68	8.9
Michigan.					
Adrian	47	—12	16.2	3.30	
Agricultural College	46	—12	12.0	3.30	15.0
Allegan	43d	—17d	11.4d	1.10	11.0
Alma	43	—19	9.8	2.19	20.0
Ann Arbor	46	—12	13.8	2.49	5.4
Arbela	43	—17	11.0	2.99	7.0
Baldwin	41	—39	3.8	0.35	4.0
Ball Mountain	42	—14	12.0	1.55	7.4
Baraga	38	—29	3.8		
Battlecreek	45	—12	13.6	2.45	6.0
Bay City	43	—19	10.6	1.70	15.0
Benzonia	38	—19	8.3	2.75	25.0
Berlin	42	—14	11.8	1.95	5.9
Berrien Springs	50	—13	16.2	2.20	14.0
Big Rapids	43	—26	7.8	3.34	14.5
Birmingham	42	—12	13.6	1.71	6.6
Calumet	34	—17	5.2	0.88	10.9
Carsonville f	42	—18	12.8	0.70	7.0
Cassopolis	45	—14	15.3	2.71	10.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Charlevoix	37	—33	3.4	0.70	7.0
Charlotte	48	—13	14.1	1.33	10.8
Chatham	35	—30	3.4	2.54	25.0
Clinton	45	—12	15.6	2.52	2.8
Coldwater	47	—11	15.8	1.50	5.0
Deer Park	34	—25	4.6	2.40	24.0
Dundee	48	—10	15.6	4.06	7.5
East Tawas	41	—20	8.0	2.22	15.9
Eloise	45	—14	13.2	.....	.....
Fennville	45	—15	14.0	1.27	10.2
Fitchburg	45	—18	12.0	3.33	11.0
Flint	44	—18	11.4	1.56	7.0
Gaylord	.....	.....	.....	1.27	12.7
Gladwin	40	—27	6.6	1.80	18.0
Grand Haven	45	—10	13.8	0.80	.....
Grand Marais	34	—23	4.2	2.40	24.0
Grape	48	—13	15.6	2.62	4.4
Grayling	42	—28	4.2	3.80	38.0
Hagar	48	—20	15.2	3.12	16.9
Harbor Beach	42	—18	10.9	1.20	7.0
Harrison	40[f]	—21[f]	7.2[f]	1.50	15.0
Harrisville	44	—20	6.6	3.82	38.2
Hart	35	—22	9.6	2.22	20.7
Hastings	44	—19	12.8	1.70	11.6
Hayes	40	—23	8.1	3.30	33.0
Highland	.....	.....	.....	3.93	23.0
Hillsdale	47	—12	13.8	3.42	11.0
Humboldt	31	—39	—1.8	0.60	6.0
Ionia	40[e]	—15[f]	9.0[f]	.....	.....
Iron Mountain	37	—29	4.2	1.40	14.0
Iron River	33	—35	1.4	1.10	12.0
Ironwood	32	—25	3.2	1.95	19.5
Ishpeming	28	—29	1.8	1.45	14.5
Ivan	36	—27	1.2	2.17	23.5
Jackson	48	—12	14.2	2.60	7.5
Jeddo	42	—16	11.6	1.86	7.8
Kalamazoo	47[e]	—13[e]	15.2[e]	1.91	15.6
Lake City	38	—21	6.2	2.90	29.0
Lansing	46	—12	12.2	1.53	9.8
Lapeer	46	—17	12.2	.....	.....
Lathrop	29[e]	—30[e]	2.2[e]	1.50	14.0
Mackinac Island	43	—23	4.8	1.58	15.8
Mackinaw City	40	—25	2.4	1.95	19.5
Mancelona	36	—33	4.1	1.10	10.0
Manistee	38	—27	10.6	4.70	47.0
Marine City	44	—13	14.4	1.09	0.7
Menominee	39	—19	6.4	1.61	16.1
Midland	42	—21	13.9	1.35	13.0
Mio	38	—25	4.7	1.65	15.7
Montague	40	—18	10.6	1.39	8.0
Mount Clemens	50	—12	14.6	2.30	18.0
Mount Pleasant[e]	45	—21	9.8	.....	.....
Muskegon	51	—18	13.1	2.95	25.0
Newberry	31	—29	2.2	.....	.....
Old Mission	38	—17	7.8	3.06	32.0
Olivet	47	—12	13.4	2.10	9.0
Omer	40	—40	3.6	1.40	8.0
Onaway	35	—24	4.4	.....	.....
Ovid	42	—16	10.4	1.71	10.0
Owosso	42	—14	11.6	.....	.....
Petoskey	37	—22	4.0	1.52	13.5
Plymouth	45	—12	14.6	0.75	6.0
Port Austin	45	—16	9.6	3.00	28.0
Powers	34	—28	3.0	1.10	11.0
Reed City	40	—28	6.8	1.63	17.8
Roscommon	38[e]	—35[e]	1.4[e]	3.50	2.7
Saginaw (W. S.)	44	—16	11.8	2.14	16.3
St. Ignace	35	—34	—1.4	.....	.....
St. Johns	45	—12	12.6	.....	.....
St. Joseph	46	— 8	13.6	1.20	12.0
Slocum	42	—23	10.0	.....	.....
Somerset[f]	47	—12	11.6	.....	.....
South Haven	50	—14	15.2	1.48	11.0
Thomaston[e]	32	—36	—0.6	0.40	4.0
Thornville	43	—13	14.4	1.57	12.5
Traverse City	38	—23	4.8	3.10	29.0
Vans Harbor	42	—34	5.6	0.90	9.0
Vassar	42	—20	10.0	2.50	14.5
Wasepi	46	—14	14.1	2.24	7.0
Webberville	45	—14	12.4	3.17	14.5
West Branch	35[e]	—20	3.6	2.50	25.0
Wetmore	40	—31	3.3	0.41	4.1
Whitefish Point	34	—27	2.4	1.09	10.9
Ypsilanti	44	—13	13.4	2.98	7.1
Minnesota.					
Albert Lea	37	.....	.....	0.40	4.0
Alexandria	.....	.....	.....	0.60	6.0
Angus[f]	39	—36	—6.1	.....	.....
Ashby	37	—25	2.0	0.87	9.2
Beardsley	43	—30	3.5	0.28	.....
Beaulieu	37	—36	—1.9	0.63	7.0
Bird Island	37	—23	3.8	0.46	4.6
Brainerd	38	—36	—4.4	1.20	12.0
Caledonia	40	—15	9.8	0.67	7.0
Collegeville	38	.....	.....	0.79	8.2
Crookston	37	—29	—6.0	1.80	18.0
Currie	35[e]	—23[e]	5.4[e]	.....	.....
Deephaven	.....	.....	.....	0.51	7.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Detroit Ctiy	40	—41	—6.6	0.85	10.0
Faribault	37	—24	5.4	0.48	7.8
Farmington	37	—22	3.4	0.80	8.5
Fergus Falls	40	—28	1.8	0.69	6.9
Floodwood	37	—38	—0.8	1.12	.....
Glencoe	35	—25	3.2	1.00	10.0
Grand Meadow	40	—18	5.5	0.87	9.0
Hallock	39	—38	—7.4	0.86	8.6
Lake Winnibigoshish	35	—36	—3.4	1.11	13.6
Leech	38	—37	—3.4	0.99	12.6
Long Prairie	39	—35	0.8	0.64	6.8
Luverne	37	—18	9.8	0.55	5.5
Lynd	40	—25	6.4	0.61	6.5
Mapleplain	36	—25	3.9	1.23	12.7
Milaca	35	—29	1.0	0.90	9.0
Milan	40	—29	3.4	1.20	12.0
Minneapolis[3]	35[e]	—25	4.7	0.82	8.1
Montevideo	41	—35	3.6	0.48	4.0
Morris	42	—25	3.3	0.29	3.5
Mount Iron	32	—35	—2.0	1.40	14.0
New London	38	—26	3.2	0.32	5.5
New Richland	38	—29	7.8	0.31	3.1
New Ulm	37	—22	5.0	0.80	8.0
Park Rapids	37	—38	—5.3	1.46	14.6
Pine River	38	—40	—3.8	1.30	16.5
Pipestone	35	—22	7.2	0.20	2.9
Pleasant Mounds	40	—22	8.1	0.52	6.0
Pokegama Falls	37	—55	—6.8	1.26	14.5
Redwing *a*	.....	.....	.....	0.63	1.7
Redwing *b*	37	—30	4.4	0.60	8.0
Reeds	.....	.....	.....	0.55	13.2
St. Charles	42	—24	7.4	1.80	18.0
St. Cloud	37	—23	3.7	0.18	2.5
St. Peter	37	—23	6.6	.....	.....
Sandy Lake Dam	35	—36	—0.6	1.48	19.1
Shakopee	36	—27	4.6	1.40	13.0
Tower	36	—45	—1.8	0.30	3.0
Two Harbors	34	—32	1.9	0.63	1.4
Wabasha	41	—23	7.0	0.51	9.8
Willow River	33	—39	0.1	1.32	15.7
Winnebago	38	—20	6.8	0.83	6.5
Winona	41	—19	8.2	0.53	8.8
Wyoming	.....	.....	.....	1.70	17.0
Zumbrota	36	—22	5.6	.....	.....
Mississippi.					
Aberdeen	80	23	46.8	1.57	
Agricultural College	.....	23	49.5[e]	1.88	
Austin	80	20	47.2	1.57	
Batesville	79	21	46.2	1.21	
Bay St. Louis	79	31	57.5	4.03	
Biloxi	78	33	58.0	3.17	
Booneville	75	22	46.8	1.64	
Canton	82	26	53.2	2.07	
Columbus	78	25	47.5	1.50	
Corinth	74	23	43.4	2.33	2.4
Crystal Springs	83	28	53.0	3.16	
Duck Hill	81	23	50.4	2.54	
Edwards	82	27	52.6	2.05	
Fayette	83	26	53.6	2.17	
Fayette (near)	.....	.....	.....	2.53	T.
Greenville *a*	79	28	51.2	1.23	
Greenville *b*	81	26	49.4	1.23	
Greenwood	84	25[e]	51.0[e]	1.83	
Hattiesburg	83	26	54.8	4.57	
Hazlehurst	83	28	53.2	3.45	
Hernando	74	21	44.0	2.74	T.
Holly Springs	75	22	43.1	1.32	
Indianola	82	26	50.1	1.30	
Jackson	83	22	51.1	2.80	
Lake	83	24	50.9	3.19	
Lake Como	81	26	54.0	4.13	
Laurel	81	.....	.....	3.12	
Leakesville	84	27	54.6	4.69	
Louisville	80	25	51.8	1.53	
McNeill	83	29	59.0	4.96	
Macon	79	.....	.....	2.02	
Magee	82	28	54.2	5.60	
Magnolia	82	27	56.4	3.83	
Natchez	85	29	56.5	1.82	
Okolona	89	22	46.0	1.46	T.
Patmos	.....	.....	.....	2.12	
Pearlington	82	29	58.8	5.12	
Pittsboro	81	23	49.9	1.72	
Pontotoc	81	23	46.6	1.19	
Poplarville	80	30	57.3	3.15	
Port Gibson	85	26	55.0	2.47	
Shoccoe	83	22	52.5	2.14	
Suffolk	83	25	55.2	1.97	
Swartwout	79	31	57.3	3.20	
Thornton	82	30	53.0	2.80	
Tupelo	81	24	46.6	1.79	
University	79	33	48.8	1.82	
Utica	84[e]	36[e]	58.2[e]	2.39[e]	
Walnutgrove	83[e]	26[e]	52.2[e]	4.26	
Watervalley	79	20	48.9	3.13	
Waynesboro	82	25	51.8	3.04	
Woodville	81	29	56.8	2.05	
Yazoo City	83	22	50.6	2.25	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri.	°	°	°	*Ins.*	*Ins.*
Appleton City	78	10	34.4	0.47	1.5
Arthur	80	10	35.9	0.37	0.5
Avalon	63	— 2	25.8	0.51	2.0
Bethany	62	— 6	22.6	0.23	2.2
Birchtree	72	14	35.9	1.65	T.
Blue Springs	68	6	29.6	0.39	T.
Boonville	.....	.....	.....	1.46	4.8
Brunswick	67	1	24.9	0.58	1.0
Carrollton	78	3	28.6	0.50	T.
Caruthersville	75	19	39.9	2.86	0.8
Conception	63	— 3	22.7	0.15	1.5
Darksville	69	— 4	27.2	0.79	1.4
Dean	82	10	41.0	0.71	T.
Desoto	66	2[e]	31.5	1.18	0.5
Downing	.....	.....	.....	0.40	2.1
Edgehill	70	9	33.4	2.12	0.2
Eightmile	.....	.....	.....	0.32	0.6
Fairport	.....	.....	.....	0.28	2.0
Fayette	66	0	26.8	0.85	1.0
Fulton	70	— 1	30.4	0.65	2.0
Gano	75	6	33.2	1.15	1.5
Glasgow	69	1	27.1	1.09	0.5
Gorin	.....	.....	.....	0.55	3.5
Grant City	60	— 5	22.2	T.	T.
Halfway	79	11	36.3	0.50	2.0
Harrisonville	67	7	28.5	0.36	0.7
Hazlehurst	.....	.....	.....	0.60	0.5
Hermann	.....	.....	.....	0.71	0.6
Houston	74	11	34.8	1.92	1.5
Huntsville	68	— 2	27.4	1.08	1.0
Ironton	70	5	33.2	2.40	0.2
Jackson	72	8	34.8	3.80	1.5
Jefferson City	74	4	29.0	0.50	2.0
Joplin	79	14	41.0	0.23	0.3
Kidder	66	— 2	24.8	0.49	0.4
Koshkonong	74	14	36.8	1.76	T.
Lamar	79	13	37.8	0.19	T.
Lamonte	.....	.....	.....	0.76	1.0
Lebanon	78	10	33.8	0.70	4.0
Lexington	67	6	29.8	0.58	0.2
Liberty	68	5	29.6	0.43	0.1
Lockwood	.....	.....	.....	0.10	T.
Louisiana	68	— 7	26.4	1.59	7.3
Macon	68	— 5	26.0	0.62	1.6
Marblehill	72	9	34.9	3.24	0.3
Marshall	69	5	28.3	0.97	0.4
Maryville	57	— 2	20.2	0.16	1.2
Mexico	69	— 2	26.8	1.09	1.8
Miami[e,5]	67	4	27.3	0.73	1.7
Mineral Springs	77	11	38.4	0.17	0.8
Monroe City	68	— 8	24.8	1.21	3.6
Montreal	79	0	34.6	0.63	3.1
Mountaingrove	74	11	34.8	1.34	3.0
Mount Vernon	80	12	37.4	0.98	T.
Neosho	80	14	41.4	0.74	0.5
Nevada	.....	.....	.....	0.24	0.7
New Haven	72	2	31.8	0.82	3.0
New Madrid	.....	.....	.....	2.22	
New Palestine	67	7	32.3	0.53	1.7
Oakfield	72	— 2	31.4	0.80	2.8
Olden	75	12	37.6	1.09	0.6
Oregon	62	0	24.1	0.12	1.0
Pine Hill	.....	.....	.....	2.60	T.
Princeton	65	— 4	21.8	0.35	3.3
Protem	77	15	40.2	1.25	3.3
Rockport	.....	.....	.....	0.07	0.5
Rolla	.....	.....	.....	0.85	3.0
St. Charles	69	— 4	30.1	0.95	1.5
St. Joseph	.....	.....	.....	0.20	2.0
Sarcoxie	.....	.....	.....	0.26	T.
Sedalia	67	8	31.9	0.88	1.0
Seymour	76	10	34.5	1.70	5.4
Sikeston	74	14	36.9	2.60	2.6
Steffenville	66	—10	24.7	1.30	3.5
Sublett	64	—18	21.5	0.33	1.5
Trenton	62	— 1	24.6	0.29	1.0
Unionville	60	— 6	20.1	1.14	3.0
Warrensburg	68	7	32.0	0.15	1.5
Warrenton	67	— 3	25.8	0.77	3.0
Wheatland	.....	.....	.....	0.52	0.5
Willowsprings	74	11	35.0	1.23	0.8
Zeitonia	74[e]	5[e]	34.4[e]	1.63	0.8
Montana.					
Adel	47	—22	18.2	0.95	9.5
Augusta	54	—20	15.8	0.15	1.0
Billings[4]	54	—42	11.6	.....	.....
Boulder	48	—14	20.3	1.09	12.8
Bozeman	49	—12	22.4	2.25	22.5
Butte	47	1	26.2	2.90	29.2
Canyon Ferry	51	—15	21.0	0.56	5.2
Chester	51	—28	2.9	0.75	7.5
Chinook	45	—25	4.4	0.36	.....
Columbia Falls	46	— 4	24.1	4.62	26.5
Crow Agency	55	—25	18.7	2.40	24.0
Culbertson	42	—34	—0.8	0.27	3.0
Cutbank	42	—40	2.4	1.10	11.0
Dayton	45	1	29.0	1.59	16.0
Deerlodge	49	— 4	26.9	.....	.....

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Montana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Dillon	54	— 2	28.4	2.14	15.4
Ekalaka	45	—20	14.0	.....	.....
Fort Benton	46	—24	7.9	0.70	7.0
Fort Harrison	57	—14	20.0	.....	.....
Fort Logan	52	—20	18.8	.....	.....
Glasgow	40	—34	1.5	0.55	.....
Glendive	40	—30	1.6	0.40	4.0
Greatfalls	52	—16	15.1	0.51	4.9
Lamedeer	52	—26	15.4	1.60	16.0
Lewistown	48	—21	16.5	1.15	11.5
Livingston	51	—18	26.4	1.80	21.5
Marysville	47	—15	17.0	2.17	25.0
Missoula	49	— 2	29.0	1.57	11.0
Ovando	43	—18	20.0	1.70	17.0
Parrot	51	—15	24.4	1.88	18.8
Philipsburg	55	—10	25.6	1.27	12.7
Plains	56	12	32.4	1.70	17.0
Poplar	38	—29	0.8	0.16	1.5
Redlodge	51	—11	21.2	1.57	22.5
Ridgelawn	40	—23	3.3	0.75	7.5
St. Pauls	51	—20	13.6	0.62	15.0
Toston	53	—18	21.2	1.70	17.0
Troy	48	4	30.6	3.64	25.0
Twin Bridges	51	—14	24.8	1.10	11.0
Two Dot	47	—22	17.4	2.87	28.5
Utica	49	—19	18.2	0.22	4.0
Wibaux	46	—28	12.0	.....	.....
Wolf Creek	49	—15	20.8	0.75	9.5
Wolsey	44	—25	16.3	2.77	33.0
Yale	43	—24	14.3	1.60	16.0
Nebraska.					
Agate	65	—23	27.0	0.16	5.5
Agee *1	58	—14	15.1	0.54	.....
Albion	63	—10	20.7	0.10	1.0
Alliance	68	—16	30.8	0.07	0.7
Alma	73	— 7	28.0	0.07	0.7
Ansley	64	— 9	24.2	0.12	1.2
Arapahoe	.....	.....	.....	T.	T.
Arcadia	.....	.....	.....	T.	T.
Ashland *a*	63	— 7	21.7	0.05	0.5
Ashland *b*	.....	.....	.....	0.12	1.0
Ashton	.....	.....	.....	0.02	T.
Auburn	60	— 5	24.2	0.21	1.0
Aurora	64	— 6	27.0	T.	T.
Bartley	73	— 8	27.8	0.05	1.0
Beatrice	65	0	25.5	0.00	
Beaver	73	— 3	29.5	0.05	0.5
Bellevue	.....	.....	.....	0.12	1.1
Benedict	.....	.....	.....	0.25	
Benkleman	.....	.....	.....	0.39	3.0
Blair	60	—10	18.2	0.09	1.3
Bluehill	.....	.....	.....	0.16	1.6
Bradshaw	.....	.....	.....	0.02	T.
Bridgeport	68	— 3	30.7	0.05	0.5
Broken Bow	74	— 6	26.2	T.	T.
Burchard	.....	.....	.....	0.04	0.5
Burwell	.....	.....	.....	0.10	1.0
Callaway	74	— 6	27.0	T.	T.
Central City	.....	.....	.....	T.	T.
Chester	.....	.....	.....	T.	T.
Cody	.....	.....	.....	0.25	2.5
Columbus	64	— 6	20.2	0.02	0.5
Crete	63	— 5	23.6	0.07	0.7
Crookston	.....	.....	.....	0.05	1.2
Culbertson	73	— 5	29.1	0.12	2.0
Curtis	.....	— 7	.....	0.10	1.0
David City	61	— 8	21.3	0.05	0.8
Dawson	62	— 2	25.6	0.05	0.5
Edgar	.....	.....	.....	0.10	1.0
Ericson	.....	.....	.....	0.40	4.0
Fairbury	66	— 7	23.3	0.19	2.0
Fairmont	67	— 9	21.2	0.15	1.0
Fort Robinson	66	—16	27.4	0.47	4.7
Franklin	73*	—10*	28.0*	0.15	1.5
Fremont	63	—10	19.6	T.	T.
Fullerton	.....	.....	.....	0.07	0.7
Geneva	67	4	25.1	0.15	1.5
Genoa (near)	62	— 8	21.8	0.02	0.1
Gering	68	2	31.7	0.25	2.0
Gordon	.....	.....	.....	0.05	0.5
Gothenburg	76	— 5	27.4	0.05	0.5
Grand Island *b*	63	— 5	24.6	0.01	0.1
Grant	.....	.....	.....	0.25	2.5
Greeley	.....	.....	.....	0.05	0.5
Guide Rock	.....	.....	.....	0.05	0.5
Haigler	.....	.....	.....	0.06	.....
Halsey	78	—14	26.6	0.03	.....
Hartington	52	—14	14.6	0.68	6.3
Harvard	64	— 8	22.7	0.02	0.2
Hastings *1	66	— 4	23.6	0.05	1.0
Hayes Center	.....	.....	.....	0.20	2.0
Hay Spring	58	—17	23.3	0.13	1.3
Hebron	68	— 5	24.4	0.07	0.5
Hickman	.....	.....	.....	T.	T.
Holbrook	.....	.....	.....	0.02	0.9
Holdrege	70	— 4	28.1	0.10	1.0
Holly	.....	.....	.....	0.50	5.0
Hooper *1	57	— 5	19.0	0.05	1.5
Imperial	74	— 8	29.0	0.02	0.5
Johnstown	.....	.....	.....	0.04	0.4
Kearney	71	— 2	26.8	0.01	0.1
Kennedy	68	—10	22.8	0.15	1.0
Kimball	73	— 6	32.1	0.49	4.0
Kirkwood	65	—12	20.6	0.48	2.7
Leavitt	64	— 6	20.7	0.00	
Lexington	73	— 5	25.8	0.15	1.5
Lockridge	66	— 7	23.3	T.	T.
Lodgepole	72	— 5	30.4	0.20	2.0
Loup	73	— 8	24.8	T.	T.
Lynch	64	—14	19.4	0.50	5.0
McCook	.....	.....	.....	0.05	0.5
McCool Junction	.....	.....	.....	T.	T.
Madison	59	—11	18.4	0.35	3.5
Madrid	74	— 6	31.4	0.20	2.0
Marquette	.....	.....	.....	0.04	T.
Mason	.....	.....	.....	0.10	1.0
Minden	70	— 7	25.5	0.11	1.1
Monroe	.....	.....	.....	0.04	0.4
Nebraska City *c*	58	— 5	22.1	0.05	0.5
Nemaha	.....	.....	.....	0.05	0.5
Norfolk	61	—14	17.4	0.21	2.5
North Loup	72	— 8	23.7	0.13	1.3
Oakdale	60	—14	16.7	0.30	2.9
Odell	.....	.....	.....	0.00	
O'Neil	65	—13	19.0	0.70	.....
Ord	.....	.....	.....	0.00	
Palmer	.....	.....	.....	0.10	1.0
Pawnee City	63	— 5	24.8	0.13	0.5
Plattsmouth *b*	.....	— 4	.....	0.10	1.0
Purdum	70	—17	23.8	0.10	1.0
Ravenna *a*	71	— 4	24.8	0.02	0.2
Redcloud	76	— 2	25.0	0.10	1.0
Republican	.....	.....	.....	0.02	0.2
Rulo	.....	.....	.....	0.05	0.5
St. Libory	.....	.....	.....	T.	T.
St. Paul	63	— 6	24.4	T.	T.
Salem	.....	.....	.....	0.06	0.6
Santee	56	—14	18.0	0.34	3.6
Schuyler	.....	.....	.....	0.05	0.5
Seward	65	— 8	23.0	0.12	1.0
Smithfield	.....	.....	.....	0.04	0.4
Spragg	.....	.....	.....	0.10	1.0
Springview	63	—15	19.0	0.25	0.5
Stanton	60	—10	19.4	0.32	3.2
Strang	.....	.....	.....	0.05	0.5
Stratton	.....	.....	.....	0.15	1.5
Superior	67	— 5	22.2	T.	T.
Syracuse	.....	.....	.....	0.05	0.5
Tablerock	.....	.....	.....	0.16	0.5
Tecumseh *b*	65	— 7	23.4	0.10	1.0
Tecumseh *c*	.....	.....	.....	0.05	0.5
Tekamah	65	— 7	20.7	0.30	3.0
Turlington	60	— 3	21.7	0.20	1.7
University Farm	63	— 7	22.6	.....	.....
Wahoo	.....	.....	.....	T.	T.
Wakefield	58	—15	16.2	0.25	2.5
Wallace	.....	.....	.....	0.30	3.0
Wauneta	.....	.....	.....	0.15	1.5
Weeping Water	.....	.....	.....	0.10	1.0
Westpoint	61	—10	18.6	0.08	0.8
Wilber	.....	.....	.....	T.	T.
Wilsonville	.....	.....	.....	0.20	2.0
Winnebago	60	—16	17.2	0.10	2.0
Wisner	.....	.....	.....	0.24	3.5
Wymore	.....	.....	.....	T.	T.
York	66	— 7	25.2	T.	T.
Nevada.					
Amos	57	2	34.8	1.91	.....
Austin	57	3	34.4	2.22	.....
Battle Mountain	62	9	37.0	1.72	7.0
Belmont	52	4	31.8	0.81	6.3
Beowawe *1	49	9	32.9	1.00	6.0
Candelaria	69	15	41.4	0.34	2.5
Carlin *1	58	12	34.4	1.40	3.0
Carson City	63	4	38.7	6.73	10.5
Cranes Ranch	.....	.....	.....	1.79	.....
Dyer	73	2	39.4	0.52	.....
Elko	58	— 6	31.0	2.20	12.0
Ely	59	— 3	32.6	1.99	14.5
Eureka	63	1	35.4	1.80	10.9
Fallon	65	9	38.2	1.03	.....
Glenbrook	.....	.....	.....	11.65	.....
Golconda *1	57	6	37.5	1.05	3.0
Halleck *1	60	2	32.5	.....	.....
Hamilton	47	20	34.4	1.65	16.5
Hawthorne	68	12	41.1	0.26	.....
Humboldt	60	13	39.5	1.52	T.
Lee	.....	.....	.....	3.34	13.0
Lewers Ranch	59	7	38.4	18.14	20.5
Lovelocks *1	55	14	31.3	1.16	.....
Martins	73	0	42.9	4.34	7.0
Mill City *1	52	10	37.0	0.90	6.0
Morey	61	— 1	35.2	1.07	6.0
Palisade	64	3	35.4	2.30	.....
Palmetto	68	— 1	37.3	0.90	9.0
Pioche	64	2	37.5	1.66	9.0
Potts	60	—15	30.4	0.37	4.5
Reno State University	60	9	38.0	4.99	2.0
Sodaville	73	11	41.1	0.21	.....
Toano *b	49	—14	27.2	0.35	.....
Wabuska	65	0	38.2	1.05	.....
Wadsworth *1	68	14	44.6	2.36	.....
Wells *1	51	— 7	33.4	1.65	12.0
Wood	58	— 3	32.6	3.84	.....
New Hampshire.					
Alstead	43	—10	15.7	1.77	16.1
Bartlett	.....	.....	.....	2.75	22.5
Berlin Mills	46	—25	11.2	1.58	13.5
Bethlehem	47	—20	12.0	1.30	10.0
Brookline *1	48	—14	17.9	2.45	12.8
Chatham	42	—24	10.4	1.60	16.5
Concord	46	—15	14.6	1.81	15.3
Durham	46	— 7	16.4	3.28	14.8
Franklin Falls	45	—12	14.6	1.79	17.5
Grafton	43	—18	13.0	1.88	12.5
Hanover	46	—17	13.3	1.06	10.1
Jefferson Highlands	.....	.....	.....	1.22	14.0
Keene	46	—12	15.6	1.45	9.5
Littleton	42	—18	12.4	1.48	5.5
Nashua	46	—11	16.8	1.99	16.5
Newton	45	—10	16.2	2.33	25.5
North Stratford	.....	.....	.....	1.60	20.1
North Woodstock	.....	.....	.....	2.56	.....
Plymouth	41	—15	13.4	1.32	18.4
Stratford	43	—20	10.0	1.36	12.0
New Jersey.					
Asbury Park	63	1	26.5	2.67	6.2
Barnegat	65	1	27.4	2.99	5.5
Bayonne	50	0	24.8	2.07	4.5
Belvidere	46	— 4	23.2	2.06	5.0
Bergen Point	53	—10	24.2	2.48	8.2
Beverly	59	1	26.2	2.08	6.2
Blairstown	45	— 6	21.5	2.10	4.0
Bridgeton	61	0	27.4	2.84	4.0
Canton	.....	.....	.....	2.35	.....
Cape May C. H.	61	4	27.8	1.62	4.2
Charlotteburg	53	— 7	20.2	3.03	8.0
Chester	49	— 6	21.4	2.69	7.0
Clayton	61	— 5	26.0	2.33	T.
College Farm	56	— 3	24.6	2.52	1.5
Dover	49	— 3	20.4	2.59	5.5
Elizabeth	53	0	25.0	2.62	.....
Englewood	50	2	24.0	2.43	4.0
Flemington	54	0	24.8	2.93	5.5
Friesburg	62	— 5	23.8	2.71	3.9
Hightstown	56	0	26.2	2.77	4.5
Imlaystown	60	0	26.0	2.89	7.5
Indian Mills	62	— 6	26.5	2.51	4.5
Lakewood	65	0	26.6	2.47	6.5
Lambertville	53	1	25.6	2.50	6.5
Layton	45	—16	19.2	1.36	.....
Moorestown	59	0	25.6	2.40	7.6
Newark	54	— 1	24.0	2.67	5.5
New Brunswick	55	0	25.6	3.09	5.9
Newton	45	— 5	20.4	2.02	3.0
Oceanic	63	— 1	25.8	2.27	6.0
Paterson	51	2	26.6	2.90	5.5
Pemberton	60	— 2	24.7	2.48	6.0
Phillipsburg	47	— 2	22.7	2.07	6.1
Plainfield	50	0	24.0	2.79	5.9
Pleasantville	.....	.....	.....	2.06	4.4
Rancocas	.....	.....	.....	2.39	7.2
Rivervale	51	— 8	22.4	2.66	10.0
Salem	59	1	27.6	2.19	3.6
Sandy Hook	55	1	25.4	2.47	6.2
Somerville	49	0	23.8	2.81	6.0
South Orange	52	0	23.4	3.05	6.0
Sussex	48	— 4	21.6	1.87	4.0
Trenton	57	2	29.9	2.61	2.0
Tuckerton	58	1	26.8	2.73	7.8
Vineland	62	2	26.7	2.76	4.2
Woodbine	60	— 4	25.8	2.31	4.5
Woodstown	.....	.....	.....	2.51	6.0
New Mexico.					
Albert	85	10	46.4	T.	T.
Albuquerque	78	25	50.8	0.10	1.0
Bellranch	.....	.....	.....	0.10	1.0
Cambray	.....	.....	.....	0.10	1.0
Carlsbad	100	12	55.6	0.11	1.1
Cloudcroft	59	8	34.2	0.10	1.0
Dorsey	76	5	40.8	0.05	1.0
Eagle Rock Ranch	71	7	38.5	0.12	1.3
Fort Bayard	78	16	45.5	0.09	2.0
Fort Stanton	75s	12s	44.4s	.....	.....
Fort Union	78	6	40.9	0.17	2.0
Fort Wingate	70	10	41.0	0.57	5.7
Fruitland	86	1	43.4	T.	T.
Gage	.....	.....	.....	0.00	
Golden	.....	.....	.....	0.22	2.2
Las Vegas	71	6	42.2	0.20	3.0
Lordsburg	.....	.....	.....	0.16	
Los Lunas	79	14	44.2	T.	T.
Luna	72	2	38.1	0.20	2.0
Mesilla Park	86	10	48.0	0.11	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New Mexico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mountainair	72	2	40.6	T.	T.
Raton	72	9	37.5	0.00	
Roswell	88	12	48.7	0.14	1.4
San Marcial	85	12	48.4	T.	T.
Strauss				T.	T.
Taos	67	6	36.8	0.90	7 0
Winsors	61	0	33.4	0.82	8.2
New York.					
Adams				6.80	62.5
Addison	58	—10	18.4	1.56	8.5
Akron				2.80	
Alden	52	—10	15.8	2.74	18.6
Amsterdam	51	—10	13.6	1.91	10.5
Angelica	46	—18	15.8	1.48	12.7
Appleton	56	— 4	16.6	2.32	
Arcade	50	—13	13.9	4.17	25.8
Athens	46	— 7	18.1	1.22	5.9
Atlanta	56	—11	16.4	2.39	10.0
Auburn	54	— 5	17.7	1.89	8.0
Avon	53	— 8	16.6	2.46	12.0
Baldwinsville	49	— 8	16.3	3.23	22.0
Ballston Lake	44	—12	13.8	1.40	9.0
Beaver				4.00	20.0
Bedford	50	— 4	22.8		
Berlin	48	— 9	17.5	2.70	13.0
Blue Mountain Lake				3.00	20.0
Bolivar	55	—17	16.0	3.04	14.5
Bouckville	47	—14	13.3	3.24	17.0
Boyds Corners				3.22	
Brockport	49	— 5	16.3	2.74	16.5
Caldwell	48	—21	13.0	3.00	14.0
Canajoharie	53	—14	13.6	1.30	10.5
Cape Vincent	38	—22	8.9	2.98	21.2
Carmel	51	— 8	17.8	3.39	10.0
Carvers Falls	43	—25	10.7	1.22	
Chazy	40	—18	9.1	0.90	9.0
Cooperstown	49	—11	13.9	3.00	15.2
Cortland	53	— 9	15.8	2.10	6.0
Cutchogue	49	2	24.7	3.61	7.0
Deansboro				2.55	15.5
Dekalb Junction	44	—23	8.0	1.97	13.5
De Ruyter	47	—11	14.3	2.83	12.9
Easton				2.19	13.0
Elba	50	—10	15.8	4.13	21.0
Elmira	58	— 7	18.6	2.21	6.2
Fayetteville	58	—12	15.8	1.92	11.0
Franklinville	52	—16	14.4	4.61	20.8
Gabriels	48[1]	—25[1]	9.4[1]	1.59	19.5
Gansevoort				2.63	14.0
Glens Falls	46	—18	11.6	2.27	11.5
Gloversville	48	—16	11.8	2.97	17.8
Greenwich	45	—18	13.2	1.40	9.0
Griffin Corners	51[4]	—11	14.6	1.75	2.2
Harkness	45	—15	10.7	0.93	6.8
Haskinville				1.74	9.2
Hemlock	54	— 7	16.6	1.25	
Indian Lake	49	—25	11.0	2.23	14.1
Ithaca	56	— 7	17.0	1.40	8.8
Jamestown	53	—12	16.8	3.31	16.7
Jeffersonville	48	—15	16.2	2.04	8.1
Keene Valley	53	—18	12.9	1.75	7.2
Le Roy	53	— 8	18.0	2.80	15.1
Liberty	46	—11	14.4	2.24	11.0
Littlefalls, City Res.	49	—13	12.0	2.28	12.5
Lockport	47	— 6	17.0	2.76	
Lowville	47	—23	10.7	2.87	17.7
Lyndonville				2.58	24.3
Lyons	54	— 5	17.6	3.23	14.5
Middletown	50	— 4	20.0	3.04	6.5
Mohonk Lake	53	— 7	17.2	1.39	9.0
Moira	47	—18	8.0	2.88	19.0
Newark Valley				1.38	7.5
New Lisbon	48	—13	13.3	1.75	6.0
North Hammond	40	—26	6.6	1.90	9.5
North Lake				3.12	20.0
Ogdensburg	43	—24	6.8	1.29	10.0
Old Chatham				3.40	8.0
Oneonta	51	— 7	17.4	2.80	14.0
Otto	52	—14	13.4	2.39	
Oxford	46	—12	15.5	2.85	13.6
Oyster Bay	50	2	25.2	3.56	5.0
Palermo				4.08	34.6
Penn Yan	57	— 7	17.4	1.38	6.4
Perry City	52	— 9	15.6	1.83	8.9
Plattsburg Barracks				0.50	5.0
Port Jervis	47	— 4	20.6	2.08	2.0
Potsdam	49	—22	8.0	1.96	13.5
Primrose	53	— 4	22.6	3.84	5.5
Redhook				1.62	
Richmondville	52	— 8	16.4	2.18	6.5
Ripley	57	—10	18.2	3.20	18.0
Rome	45	—14	14.2	2.55	22.0
Romulus	55	— 5	18.6	1.50	6.7
Salisbury Mills				1.85	6.5
Saranac Lake	46	—19	10.3	2.21	11.2
Saratoga Springs	46	—18	12.5	2.37	13.3
Scarsdale	50	— 2	22.8	1.70	8.0
Setauket	49	0	24.5	2.93	4.1
Shortsville	55	—10	17.0	2.11	12.7
Skaneateles				3.17	
Southampton	48	1	25.0	2.94	9.0
South Butler	50	—10	16.3	2.94	14.7
South Canisteo	55	— 9	16.2	3.85	18.5
Southeast Reservoir				3.10	
South Kortright	52	—11	15.0	1.67	9.0
South Schroon	48	—19	11.4	1.83	16.7
Spier Falls	50	—15	13.4	2.10	11.5
Straits Corners	55[e]	—11[d]	15.0[e]		
Ticonderoga	50	—21	12.0	1.18	12.0
Volusia	50	—13	15.4	3.99	20.0
Wappinger Falls	47	—10	18.2	2.66	12.0
Warwick				1.67	6.0
Watertown	44	—22	12.1	3.27	21.5
Waverly	58	— 8	19.2	1.53	6.3
Wedgwood	49	—10	15.0	1.77	8.5
Wells	49	—23	11.8	2.54	17.7
West Berne	53	—17	14.4	1.72	9.0
Westfield *b*	54	—11	16.6	3.03	
Windham	55	— 9	16.6	1.27	5.6
Youngstown				2.81	8.5
North Carolina.					
Brevard	70	3	38.0	2.92	T.
Brewers	74	1	35.2	2.95	2.0
Bryson City				3.72	0.5
Chapelhill	76	12	36.0	4.55	2.0
Currituck				1.78	4.0
Edenton	79	12	37.6	5.91	6.0
Fayetteville	78	17	41.4	4.46	1.0
Goldsboro	78	17	38.3	4.63	3.9
Graham				4.13	1.0
Greensboro	69	12	35.0	3.88	2.5
Henderson	74	11	35.8	3.98	7.5
Hendersonville	73	3	37.2	3.80	0.3
Henrietta	70	13	39.2	3.75	0.3
Hot Springs	70	12	39.0		
Jefferson	71	1	34.0	2.56	2.2
Kinston	75	17	38.2	4.10	0.2
Kittyhawk	72	14	39.5	4.08	4.0
Lenoir	72	5	36.6	2.60	0.5
Linville	63	— 1	31.1	2.97	3.0
Littleton	75	7	33.8	3.95	7.5
Louisburg	75	9	36.7	4.62	4.0
Lumberton	73	19	39.0	4.44	1.0
Marion	70	8	38.1	3.36	1.0
Marshall	73	5	40.4	1.72	1.1
Mocksville				2.95	1.2
Moncure	76	8	38.0	4.41	2.5
Monroe	75	13	38.6	4.15	0.5
Morganton	71	5	38.6	3.73	1.6
Mountairy	67	3	34.3	2.59	2.0
Murphy				4.13	
Newbern	78	15	40.7	5.47	
Patterson [1]	64	6	33.6	2.90	1.0
Pittsboro	70	12	35.7	4.50	2.0
Reidsville	68	9	35.4	2.85	3.5
Rockingham	82	19	40.5	3.52	1.0
Salem	67	5	35.8	3.88	3.0
Salisbury	70	14	39.1	3.93	
Saxon	68	2	35.0	2.46	3.0
Selma	77[e]	17	39.1	3.58	2.0
Settle	69	4	38.2	3.44	3.7
Sloan	79	18	43.0	4.08	0.1
Soapstone Mount	74	5	36.8	4.58	2.5
Southern Pines *a*	76	16	41.3	4.40	
Southern Pines *b*	73	16	40.8	4.86	1.4
Southport	74	20	44.9	3.11	
Statesville	68	7	37.7	3.87	0.5
Tarboro	78	14	38.0	4.24	4.5
Washington	79	15	39.8	5.94	4.0
Waynesville	69	8	35.0	2.15	T.
Weldon *a*	76	6	34.4	4.20	9.7
Weldon *b*				4.23	9.4
Whiteville	77	19	43.6	3.05	1.0
North Dakota.					
Amenia	43	—28	—0.4	0.50	5.0
Ashley	36	—35	—2.0	0.80	8.0
Berlin	38	—38	—3.6	0.64	6.4
Bottineau	35	—32	—6.8	0.81	8.1
Buxton	39	—29	—2.0	1.72	17.2
Churchs Ferry	37	—32	—7.3	0.60	6.0
Cooperstown	50	—32	—3.4		
Devils Lake	38	—33	—6.4	0.55	5.5
Dickinson	40	—23	4.1	0.60	6.0
Donnybrook	37	—30	—4.2	0.70	7.0
Dunseith	35	—31	—5.4	1.10	11.0
Edgeley	49	—29	—0.2	0.17	2.5
Elbowoods	44	—32	—6.5	0.95	9.7
Ellendale	42	—30	0.5	0.70	7.0
Fargo	41	—30	—3.1	0.45	4.5
Forman	40	—31	—0.4	0.41	5.0
Fort Yates	51	—28	1.5	0.52	6.1
Fullerton	41	—33	0.4	0.88	8.8
Glenullin	38	—24	2.2	0.41	3.8
Hamilton	39	—32	—6.6	1.05	10.4
Hannaford	52	—35	—3.7	1.10	11.0
Jamestown	45	—34	—3.2	1.10	11.0
Kulm [e]	40	—30	—0.4	0.54	9.7
Larimore	38	—28	—2.2	0.60	6.0
Lisbon	44	—32	—2.9	1.30	13.0
McKinney	36	—42	—7.0	0.60	6.0
Manfred	39	—39	—1.1	0.55	5.5
Mayville	40	—29	2.3[e]	0.91	9.2
Medora	48	—26	5.8	0.50	5.0
Melville	40	—28	—0.9	T.	T.
Milton	35	—41	—10.6		
Minnewaukon	39	—30	—2.6	0.57	5.7
Minot	40	—34	—1.8	0.15	1.5
Napoleon	38	—31	—2.8	0.35	4.0
New England	40	—26	4.8	0.80	8.0
Oakdale	46	—26	4.0	1.00	10.0
Park River	40	—30	—4.6	1.02	10.2
Pembina	41	—38	—9.8	0.70	7.0
Portal	33	—33	—7.0	0.40	4.0
Power	43	—31	—2.2	0.85	8.5
Steele	36	—29	—1.2	0.59	5.9
University	37	—26	—0.1	1.10	11.0
Wahpeton	38	—23	4.0	0.30	3.0
Willow City	37	—35	—6.4	0.80	8.0
Ohio.					
Akron	56	—11	20.2	3.62	6.8
Atwater				3.21	3.5
Bangorville	58	—10	21.2	3.27	
Bellefontaine	60	— 8	21.0	2.88	12.0
Benton Ridge	54	— 6	22.1	3.18	4.3
Bladensburg	62	—18	23.0	2.85	4.6
Bowling Green	52	— 8	19.0	2.91	2.5
Cadiz	60	— 8	23.8	2.70	6.7
Cambridge	72	—13	25.2	1.67	2.0
Camp Dennison	66	— 2	28.8	2.55	4.1
Canal Dover	57	—17	22.4	3.31	4.5
Canton	57	— 8	21.3	3.06	7.4
Cardington	60	—17	21.4	3.44	6.1
Circleville	67[e]	— 3	27.6	2.81	10.5
Clarington	69	— 1	29.2	2.69	10.6
Clarksville	64	— 4	27.1	2.18	1.6
Cleveland *a*	57	— 8	19.9	3.00	7.5
Cleveland *b*	57	— 8	18.6	2.33	6.5
Clifton	65	— 5	24.5	2.00	5.0
Coalton	70	— 6	29.0	1.65	5.0
Crooksville	65	—13	26.6	1.16	5.1
Dayton *a*				1.88	7.8
Dayton *b*	64	— 6	25.4	2.53	7.2
Defiance	55	— 8	19.4	3.47	3.4
Delaware	62	—13	21.8	2.15	4.5
Demos	68	— 7	26.0	1.25	2.0
Elyria	58	—10	20.2	1.48	
Findlay	55	— 7	21.0	2.84	2.0
Frankfort	69	—12	26.6	2.06	9.0
Fremont	54	— 7	20.3	4.18	3.5
Garrettsville	58	—15	19.8	3.20	7.0
Granville	58	—11	24.1	2.46	3.7
Gratiot	63	— 9	23.4	2.38	5.6
Green	72	1	31.1	2.45	2.0
Greenfield	66	1	28.1	1.60	5.0
Greenhill	58	—13	20.2	3.15	7.6
Greenville	60	— 5	22.6	2.56	6.5
Hanging Rock	73	— 2	32.0	2.22	4.5
Hedges	51	—12	19.0	2.46	3.8
Hillhouse	58	—16	15.8	2.52	6.5
Hiram	56	—12	18.6	2.14	5.5
Hudson	55	—16	17.8	2.75	4.0
Jacksonboro	64	— 4	25.7	2.31	10.0
Kenton	60	—10	20.0	3.71	3.4
Killbuck	60	—10	21.5	3.30	3.5
Lancaster	69	—10	25.6	2.03	4.5
Lima	60	— 7	20.7	2.80	4.0
McConnelsville	68	— 8	25.6	1.91	7.2
Manara	64	— 5	25.3	1.71	5.0
Mansfield				3.78	7.8
Marietta	68	0	30.0	1.82	6.5
Marion	62	— 9	21.8	3.87	4.6
Medina	55	—17	19.0	2.86	4.0
Milfordton	59	—11	22.2	2.74	6.7
Milligan	67	—17	25.8	2.09	7.0
Millport	60	—14	21.1	3.11	7.5
Montpelier	49	—10	17.4	4.39	4.0
Napoleon	52	— 6	19.5	3.34	1.9
Nellie	60	— 7	24.0	3.30	5.8
New Alexandria	58	— 9	24.6	3.80	
New Berlin	55	—11	20.4	3.19	7.0
New Bremen	60	—11	20.7	2.80	8.0
New Richmond	75	0	31.0	1.83	3.0
New Waterford	59	—12	22.5	3.98	
North Lewisburg	60	—10	21.2	2.25	5.5
North Royalton	48	—14	17.9	3.71	7.0
Norwalk	56	—10	19.6	2.90	2.5
Oberlin	57	—12	19.8	2.99	3.8
Ohio State University	65	—11	23.8	1.45	5.8
Orangeville	55	—14	19.9	4.23	3.0
Ottawa	52	— 8	20.2	2.73	3.5
Pataskala	64	— 7	23.8	2.12	5.3
Philo	66	— 5	26.5	0.75	4.7
Plattsburg	63	— 5	23.8	2.12	6.0
Pomeroy	68	1	29.7	1.85	5.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Portsmouth *a*				1.90	3.0
Portsmouth *b*	71	2	31.4	1.88	3.2
Pulse	64	— 2	27.8	1.95	4.5
Richwood	61	—14	21.8	2.36	4.6
Rittman	57	— 9	21.0	4.20	5.2
Rockyridge	53	—12	18.0	3.52	2.7
Shenandoah	57	—12	19.2	3.49	3.9
Sidney	63	— 7	23.4	2.10	5.7
Somerset	64	— 6	25.8	1.72	15.6
Springfield				2.14	8.7
Thurman	73	— 2	30.6	1.95	5.0
Tiffin	57	— 8	20.2	2.99	3.5
Upper Sandusky	59	— 9	20.8	3.71	2.5
Urbana	51	— 6	20.0	2.14	5.0
Vickery	54	—11	18.4	2.83	4.0
Warren	54	— 9	20.4	3.47	7.1
Wauseon	50	— 9	17.4	3.23	4.6
Waverly	60	— 3	29.6	2.02	4.7
Waynesville	59	— 3	24.1	2.08	
Wellington	57	—11	20.6	3.57	6.5
Willoughby				1.22	4.2
Wilson	70	— 5	29.6	2.32	3.8
Wooster	57	—10	20.5	3.90	5.0
Zanesville				1.85	5.2
Oklahoma.					
Arapaho	92	7	43.3	T.	T.
Beaver	90	5	38.9	0.05	
Binger	91	10	45.2	0.15	0.2
Blackburn	90	15	43.6	T.	T.
Chandler	88	14	42.8	0.08	T.
Cleo	94	4	44.0	0.00	
Cloud Chief	92	5	44.6	T.	T
Eldorado	98	6	48.1	0.00	
Enid	85	10	40.2	T.	T.
Fort Reno	93	10	45.8	0.20	2.0
Fort Sill	92	14	47.2	T.	T.
Guthrie	88	14	43.2	0.05	
Harrington	91	7	44.0	T.	T.
Hennessey				0.01	T.
Hobart	92	11	49.2	T.	T.
Jefferson	81	8	40.3	0.00	
Jenkins	88	5	41.6	T.	T.
Kenton	81	3	42.6	T.	T.
Kingfisher	91	12	44.8	0.10	1.0
McComb	87	15	45.9	0.07	T.
Mangum	95	10	46.5	T.	
Meeker	85	14	47.0	0.10	1.0
Newkirk	81	11	41.4	0.00	
Norman	90	14	46.4	0.06	0.4
Pawhuska	82	11	41.6	0.00	
Perry	89	10	43.1	T.	T.
Sac and Fox Agency	88	16	41.8	0.09	
Shawnee	89	15	42.5	0.09	2.0
Stillwater	90	12	42.1	0.07	2.0
Taloga	93	5	41.2	0.00	
Temple	92	11	48.6	0.07	0.5
Watonga	92[c]	8[c]	43.3[c]	0.00	
Waukomis	91	9	45.0	0.02	0.2
Weatherford	90	9	41.4	T.	T.
Whiteagle	83	11	42.6	0.00	
Woodward	90	3	40.7	T.	T.
Oregon.					
Albany				12.20	1.0
Alpha	56	26	40.4	26.90	3.2
Arlington	57	21	38.2	2.68	6.0
Ashland	61	24	40.3	5.89	4.1
Astoria	54	28	40.4	13.80	8.0
Aurora (near)	56	27	39.8	10.13	0.2
Bay City	53	28	40.4	17.91	2.0
Bend	57	4	35.4	4.27	11.8
Beulah	53	— 1	33.6	0.90	6.5
Blackbutte	44	28	36.3	17.32	12.0
Blalock	57	26	39.2	2.20	5.0
Bullrun				12.75	9.5
Burns	51[f]	— 3[f]	30.6[f]	2.52	15.0
Burns (near)				2.93	15.0
Butter Creek				1.86	7.5
Cascade Locks	50	28	37.4	14.94	15.0
Coquille				14.76	
Corvallis	57	21	40.8	15.23	3.3
Dayville	56	47	38.6	2.56	5.5
Detroit	59	15	33.5	16.83	32.5
Doraville	49	22	35.9	12.79	36.2
Drain	57	28	41.8	17.02	4.0
Ella				1.93	3.0
Eugene	57	29	41.4	12.10	0.5
Fairview	60	27	43.5	22.31	1.5
Falls City	53	23	37.7	23.72	7.3
Forestgrove	56	25	39.2	14.91	7.0
Gardiner	63	33	46.4	20.15	
Glenora	50	24	36.2	26.31	32.5
Gold Beach	60	33	45.3	25.40	
Government Camp	48	2	28.3	14.93	127.0
Grants Pass	61	27	40.6	12.99	
Grass Valley	60	11	35.5		
Hood River (near)	50	19	35.4	8.96	43.2
Huntington	58	13	32.3	3.15	25.0
Jacksonville	63	25	43.8	10.57	3.0
Oregon—Cont'd.					
John Day	59	7	39.0	1.65	5.5
Joseph	52	— 1	29.5	2.80	27.0
Kerby	59	25	39.6	30.83	9.0
Klamath Falls	47	0	30.8	4.60	11.0
Lagrande	54	9	34.4	2.46	10.0
Lakeview	47	2	28.6	5.45	23.5
Langlois	56	28[f]	45.6[d]	20.17	
Lonerock	59	7	36.1	2.27	5.5
McKenzie Bridge	55	18	35.7	18.59	
McMinnville	56[f]	24	40.0[d]	12.34	5.2
Meacham				4.60	20.2
Monroe	56	25	40.8	18.25	3.0
Mount Angel	56	29	40.4	9.62	1.5
Nehalem				16.70	4.0
Newport	55	31	43.2	13.92	
Ontario				5.48	9.0
Pine	49	— 5	26.6	3.57	32.0
Prineville	56	8	36.0	1.19	
Riverside	53			1.05	6.0
Salem	55	30	41.4	9.47	0.9
Sparta	48	6	28.5	4.35	42.0
Stafford	55	27	39.4	12.06	
The Dalles	52	21	36.6	4.50	26.5
Toledo	55	28	42.4	16.81	0.5
Umatilla	56	15	39.7	1.46	0.5
Vale	57	12	32.8	2.16	9.2
Wallowa	54	— 3	28.9	3.75	22.0
Wamic	56	15	34.1	4.35	38.0
Warm Spring	52	11	37.2	3.08	11.5
Weston	58	12	35.5	3.81	13.8
Williams	74	23	40.8	13.73	2.0
Pennsylvania.					
Aleppo	63	— 9	24.0	2.12	12.0
Altoona	60[e]	— 8[e]	22.2[e]	2.39	
Athens	55	— 6	18.8	1.15	4.8
Beaver Dam				3.03	5.0
Bellefonte	65	— 5	23.9	2.52	4.0
Brookville				1.70	6.2
California	63	— 3	28.1	1.90	5.9
Cassandra	58	—10	20.4	3.41	12.0
Centerhall	57	— 8	20.2	2.07	3.5
Clarion				3.78	9.4
Coatesville	55	0	24.4	2.24	6.6
Coudersport	54	—16	16.0		
Confluence				2.66	
Davis Island Dam				2.27	3.0
Derry	65	—11	25.7	3.50	12.8
Doylestown				2.89	
Dushore	51	—12	17.8	0.99	3.2
East Bloomsburg				1.30	1.5
East Mauch Chunk	57	— 8	21.6	1.31	3.5
Easton	45	— 2	23.1	1.53	4.6
Ellwood Junction				2.52	3.5
Emporium	57	— 6	20.0	3.09	10.0
Ephrata	54	— 1	23.4	1.64	3.0
Everett	63	— 6	20.0	1.90	2.0
Franklin	59	—14	20.4	3.87	2.0
Freeport	59[d]	—12[d]	23.1[d]	2.73	5.7
Gettysburg	54	0	25.3	1.72	2.0
Girardville				2.91	7.2
Gordon	54	—12	20.0	2.60	3.0
Grampian	45	—16	16.8	3.09	15.5
Greensboro				2.26	1.5
Greenville	58	— 9	20.4	3.36	7.5
Hamburg	54	— 2	22.8	2.33	3.5
Hawthorn	68	—18	18.8	4.80	10.0
Herrs Island Dam				2.13	3.0
Huntingdon *a*				1.47	3.0
Huntingdon *b*	59	— 5	23.0	2.39	3.7
Indiana	51	—12	20.2	3.10	15.5
Irwin	59	—10	25.4	2.24	5.2
Johnstown	62	— 5	24.0	3.75	13.1
Keating				2.11	4.0
Kennett Square	57	0	25.2	2.21	6.6
Lansdale				2.07	
Lawrenceville	59	—14	19.2	3.06	6.5
Lebanon	49	— 3	23.3	2.22	3.0
Leroy	54	—10	16.5	1.13	6.0
Lewisburg	53	—12	21.4	1.62	3.3
Lockhaven *a*	52	— 4	21.9	2.33	3.5
Lockhaven *b*				1.78	6.0
Lock No. 4				2.71	10.5
Lycippus	64	— 7	25.0	3.22	12.6
Marion	59	— 6	23.5	1.82	3.0
Mifflin				1.50	1.5
Mifflintown	58	— 7	21.6	1.54	1.5
Milford	49	—10	20.1	2.12	5.2
Montrose	51	—11	16.2	1.84	16.0
New Germantown	63	— 7	23.7	1.76	12.0
Oil City				3.51	5.1
Ottsville				2.32	
Parker				3.10	6.2
Philadelphia	56	4	27.8	2.36	6.4
Pocono Lake	50	—10	17.6	2.16	10.0
Point Pleasant				2.21	
Pottsville				2.20	
Quakertown	53	— 1	24.6	2.40	7.2
Reading	51	— 1	24.8	2.22	
Pennsylvania—Cont'd.					
Renovo *a*	58	— 4	21.3	2.53	5.3
Saegerstown	44	—18	18.4	3.28	15.0
St. Marys	50	—11	17.0	2.82	12.0
Saltsburg				3.34	7.0
Seisholtzville				2.37	
Selinsgrove	57	—10	22.0	3.76	2.0
Shawmont				2.30	
Skidmore	60	—13	21.2	2.34	6.5
Smethport	55	—27	16.6		
Smiths Corners				2.18	
Somerset	48	—11	18.9	4.29	20.4
South Eaton	57	— 4	21.8	1.67	3.0
State College	58	— 8	19.3	3.28	8.3
Sunbury				0.43	3.0
Swarthmore	57	1	25.6	2.85	7.5
Towanda	53	— 5	19.6	1.06	6.0
Troutrun				1.00	1.0
Uniontown	63	— 3	27.0	2.61	5.0
Warren	57	—11	18.4	2.47	5.2
Wellsboro	54	— 5	19.0		8.5
Westchester	56	0	24.8	2.53	7.0
West Newton				3.04	8.5
Wilkesbarre	54	— 3	21.0	1.59	2.0
Williamsport	52	— 3	21.9	1.10	1.0
York	58	— 1	25.8	1.08	4.6
Rhode Island.					
Bristol	45	2	23.5	3.20	8.5
Kingston	48	— 4	21.6	4.21	9.5
Pawtucket	46	0	22.2	3.75	12.0
Providence *a*	50	2	23.7	3.38	13.0
Providence *c*	50	— 1	21.8	3.14	11.0
South Carolina.					
Aiken	76	22	46.2	3.59	
Allendale	73	28	53.0	1.95	
Anderson	82	21	43.4	3.12	
Barksdale	71	20	41.9	3.79	0.5
Batesburg	75	20	44.0	4.71	0.9
Beaufort	75	26	50.8	4.60	
Bennettsville	78	21	44.4	2.97	1.5
Blackville	77	22	46.0	4.08	
Bowman	78	24	47.0	4.23	
Calhoun Falls				3.72	
Camden				3.80	T.
Cheraw *a*	75	20	41.0	3.90	T.
Cheraw *b*				3.97	0.1
Clarks Hill	73	23	45.3	3.21	2.1
Clemson College	81	15	42.4	3.87	
Conway	79	20	44.8	3.52	
Darlington	76	19	44.6	3.57	
Dillon	77[e]	20[g]	43.9[f]	3.20[e]	
Due West	73	22	41.6	3.79	
Effingham				4.34	T.
Florence	86	22	45.8	3.34	
Gaffney	68	16	38.9	3.02	T.
Gillisonville	81	21	48.7	3.81	T.
Greenville	71	16	37.6	4.18	
Greenwood	71	22	40.8	4.43	
Heath Springs	70	18	38.6	3.16	
Kingstree *a*	76	20	46.4	3.78	T.
Kingstree *b*				3.74	T.
Liberty	70	16	41.0	3.65	
Little Mountain	74	21	42.8	3.43	2.3
Lugoff	76	20	43.5	3.61	T.
Newberry	73	22	42.5	4.18	
Pinopolis[*1]	72	26	47.6	4.60	
St. Georges	76	24	46.2	4.32	T.
St. Matthews	74	23	45.2	4.81	T.
St. Stephens				4.06	
Saluda	73	20	44.0	3.28	1.5
Santuck	74	17	41.0	3.92	0.8
Smiths Mills				2.76	T.
Society Hill	73	22	42.5	2.93	1.0
Spartanburg	73	17	39.8	3.03	T.
Statesburg	76	22	45.6	3.75	
Summerville	79	22	45.4	4.87	
Sumter				2.06	
Trenton	73	22	44.4	2.97	0.7
Trial	75	18	46.2	3.80	
Walhalla	71	16	41.5	4.05	
Walterboro	82	23	50.8	5.35	
Winnsboro	72	24	44.0	3.26	T.
Winthrop College	70	20	40.5	3.71	1.0
Yemassee	79	26	48.8	4.77	
Yorkville	74[g]	20[g]	43.8[g]	3.58	0.8
South Dakota.					
Aberdeen	40	—32	2.4	1.26	9.8
Academy	49	—17	14.7	0.42	4.3
Alexandria	46	—21	9.8	0.90	9.0
Armour	54	—20	13.2	0.57	6.8
Ashcroft	50	—21	13.6	0.70	7.0
Bowdle	39	—26	3.2	0.50	5.0
Brookings	40	—24	7.2	0.15	1.5
Canton	52	—17	12.8	0.46	6.0
Cavite	48	—20	14.7	0.05	0.5
Centerville				0.32	3.2
Chamberlain	48	—15	14.2	0.71	4.0
Cherrycreek	50	—36	11.2	0.45	13.0
Clark	36	—28	5.4	0.49	5.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Clear Lake	36	—26	4.2	0.61	.....
Desmet	40	—24	6.8	0.50	5.0
Doland	40	—29	5.8	0.38	4.8
Elkpoint	60	—13	16.2	1.67	9.0
Fairfax	52	—15	16.3	.....	.....
Farmingdale	.....	.....	.....	0.87	3.0
Faulkton	41	—28	5.1	0.55	5.2
Flandreau	38	—24	6.4	0.42	4.2
Forestburg	39	—25	6.8	0.65	6.5
Fort Meade	61[1]	—22	15.6[e]	.....	
Gannvalley	40	—21	10.4	0.50	7.0
Gettysburg	43	—25	4.8	0.96	8.5
Grand River School	47	—30	2.2	0.62	6.0
Greenwood	59	—14	18.4	0.45	4.0
Highmore	46	—24	8.6	0.17	1.8
Hotch City	46	—21	12.4	0.21	3.0
Howard	38	—22	8.7	0.20	2.5
Howell	44	—26	6.2	0.20	2.4
Ipswich[e]	35	—30	—0.2	.....	.....
Kidder[j]	41	—39	—0.4	.....	.....
Kimball	43	—21	10.4	0.50	5.0
Leola	40	—28	1.5	0.57	12.5
Marion	45	—19	11.5	0.70	5.0
Mellette	42	—30	5.7	0.40	4.0
Menno	50	—19	12.6	0.46	4.0
Millbank	45	—27	3.2	0.90	6.0
Mitchell	43	—22	8.5	0.56	10.0
Oelrichs	67[e]	—22[e]	19.3[e]	0.45	4.5
Pedro	48	—22	11.4	0.16	2.0
Pine Ridge	69	—17	23.1	0.09	1.5
Plankinton	44	—23	10.0	0.63	7.1
Ramsey	40	—24	8.3	0.60	6.0
Redfield	42	—30	2.8	0.54	9.5
Rosebud	60	—27	19.3	0.70	5.5
Silver City	.....	.....	.....	2.95	29.5
Sioux Falls	47	—21	9.5	0.45	5.0
Sisseton Agency	40	—26	3.2	0.44	4.4
Spearfish	58	—19	20.0	2.13	15.0
Stephan	41	—21	9.0	0.47	4.7
Tyndall	55	—16	15.4	0.34	2.5
Vermillion	58	—13	16.0	0.20	3.0
Watertown	38	—27	4.0	0.46	6.5
Wentworth	39	—22	7.2	0.42	4.2
Wolsey	.....	.....	.....	0.50	4.5
Tennessee.					
Andersonville	67	12	37.9	3.05	
Ashwood	72	18	42.9	1.00	
Bluff City	.....	.....	.....	2.69	T.
Bolivar	77	19	41.6	1.38	
Bristol	65	9	35.4	1.56	T.
Brownsville	75	21	43.4	0.98	
Byrdstown	72	11	39.8	1.66	2.9
Carthage	72	16	42.8	1.69	T.
Cattlettsburg	.....	.....	.....	5.07	1.2
Cedar Hill	73	13	39.4	2.45	1.0
Celina	.....	.....	.....	1.38	.....
Charleston	.....	.....	.....	3.02	2.2
Clarksville	73	14	39.1	2.32	1.0
Clinton	.....	.....	.....	4.00	5.0
Covington	77	21	43.7	0.85	
Decatur	74	8	41.0	3.28	1.0
Dickson	74[e]	14	40.4	1.71	
Dover	76	15	40.4	3.22	0.5
Dyersburg	76	20	38.8	2.32	T.
Elizabethton	70	12	38.6	3.28	0.1
Erasmus	72	6	38.2	2.68	0.5
Florence	73	15	41.9	0.98	T.
Franklin	74	12	40.2	1.52	T.
Grace[e,1]	74	16	39.8	3.80	1.0
Greeneville	72	10	40.0	4.15	1.4
Halls Hill	.....	.....	.....	1.36	T.
Harriman	79	8	40.4	3.97	T.
Hohenwald	77	12	42.0	2.02	
Iron City	77	18	44.8	1.96	
Isabella	68	15	40.8	3.12	T.
Jackson	77	11	43.4	1.30	
Johnsonville	76	14	42.3	1.32	T.
Jonesboro	71	13	38.9	4.26	0.9
Kenton	76	18	41.0	2.53	1.0
Kingston	.....	.....	.....	3.20	0.4
Lafayette	69	10	38.6	1.32	
Leadvale	.....	.....	.....	3.80	0.2
Lewisburg	73	17	43.7	1.48	T.
Liberty	73	13	41.6	1.82	1.4
Lynnville	71	18	42.0	1.21	
McMinnville	73	13	42.4	1.81	0.4
Maryville	71	11	41.2	4.26	0.3
Newport	73	13	40.4	3.87	
Palmetto	69	16	42.1	1.34	T.
Pope	75	14	42.8	2.05	
Rogersville	71	11	39.2	3.86	T.
Rugby	76	6	37.5	3.32	4.0
Savannah	77	19	45.6	1.43	
Sewanee	69	13	39.4	1.66	T.
Silverlake	68	2	34.5	2.93	2.0
Springdale	71	4	37.3	3.72	2.0
Springville	77	14	41.6	1.92	1.3
Tazewell	.....	.....	.....	3.72	5.0
Tennessee—Cont'd.	°	°	°	*Ins.*	*Ins.*
Tellico Plains	72	18	43.8	3.16	T.
Tracy City	71	10	40.4	1.92	
Trenton	77	20	43.2	1.36	
Tullahoma	72	15	42.8	1.43	0.2
Waynesboro	76	18	44.4	1.53	
Wildersville	74[b]	18[c]	43.0[c]	0.95	0.5
Yukon	72	17	44.3	1.25	
Texas.					
Albany	95	18	49.8	0.20	2.0
Alvin	83	31	60.0	1.35	
Arthur	.....	.....	.....	1.86	0.5
Athens	90	24	56.4	.....	
Austin *a*	87	24	57.6	1.59	
Ballinger	93	19	51.5	0.79	5.0
Beaumont	.....	.....	.....	2.57	
Beeville	96	27	62.7	0.39	
Bigspring	94	11	54.4	T.	T.
Blanco	90	19	53.0	2.00	
Boerne[e,1]	96	25	53.6	1.33	
Bonham	84	23	49.8	1.72	2.0
Booth	.....	.....	.....	0.95	
Bowie	92	18	50.7	0.71	2.1
Brazoria	82	25	61.4	0.70	
Brenham	83	29	57.6	5.52	
Brighton	78	26	60.6	1.00	
Brownwood	85	21	49.2	1.10	1.0
Burnet	99	19	57.6	2.92	
Camp Eagle Pass	100	21	62.0	0.15	
Childress	95	10	48.6	T.	
Claytonville	94	15	53.1	0.03	0.3
Coleman	98	19	56.0	1.00	4.5
College Station	84	28	58.7	1.75	
Colorado	99	10[d]	54.5	0.02	T.
Columbia	81	23	60.2	1.32	
Columbus	.....	.....	.....	3.42	
Comanche	96[e]	19[e]	51.8[e]	2.11	
Comstock	97	27	58.8	0.42	
Corsicana	85	25	53.7	2.48	
Cuero	82	24	57.3	1.73	
Dallas	89	23	50.2	1.66	
Danevang	81	28	60.2	1.16	
Dialville	82	26	55.0	2.93	
Dublin	92	21	51.8	3.00	
Duval	92	25	56.6	1.94	
Estelle	90	23	54.0	1.85	
Fort Brown	86	36	66.2	0.46	
Fort Clark	94	25	59.0	0.46	
Fort Davis	85	10	52.0	T.	T.
Fort McIntosh	98	26	64.3	0.50	
Fort Ringgold	96	33	68.8	0.25	
Fort Stockton	.....	.....	.....	T.	
Fredericksburg	91	19	55.0	2.16	
Gainesville	83[d]	21[b]	48.0[c]	1.55	2.5
Georgetown	98	21	55.6	3.31	
Grapevine[b]	92	24	57.2	1.76	1.0
Greenville	85	23	50.3	1.45	
Hale Center	91	12	48.7	0.20	
Hallettsville	86	24	60.3	1.46	
Haskell	94	15	52.7	0.26	2.0
Hearne	100	31	64.8	2.18	
Hempstead	.....	.....	.....	3.35	
Henrietta	94	17	48.5	0.27	2.7
Hewitt	.....	.....	.....	3.72	
Hillsboro	87	23	52.7	2.10	
Hondo	95	24	57.4	0.55	
Houston	84	29	59.4	2.43	
Huntsville	88	29	56.8	1.92	
Ira	96	12	52.8	0.02	
Jasper	85	27	59.9	3.69	
Jefferson	79	23	53.5	2.81	0.5
Jewett	85	33	62.2	3.64	
Junction	.....	.....	.....	1.44	
Kaufman	84	24	54.3	1.60	T.
Kent	89	11	54.4	0.01	T.
Kerrville	82	29	56.2	1.27	
Knickerbocker	96	14	55.6	0.43	4.0
Kopperl	.....	.....	.....	2.52	
Lampasas	96	19	52.4	3.57	
Lapara	.....	.....	.....	2.25	
Laureles Ranch	.....	.....	.....	1.47	
Liberty	.....	.....	.....	2.20	
Llano	94	31	57.9	3.80	
Longview	80	21	53.2	2.92	
Luling	88	23	57.7	0.93	
McKinney	81	24	52.2	1.79	
Mann[d]	85	25	55.9	2.88	
Marlin	87	26	53.8	2.92	
Menardville	94	17	52.0	2.53	
Mount Blanco	92	7	47.4	0.02	
Nacogdoches	84	23	55.4	3.86	
New Braunfels	89	26	59.5	0.71	
Orange	.....	.....	.....	1.10	
Panter	.....	.....	.....	2.05	T.
Paris	84	23	48.4	1.17	
Pearsall	95	28	62.4	0.56	
Pecos	94	14	56.6	T.	T.
Port Lavaca	79	32	60.6	0.45	
Rhineland	94	15	47.8	0.15	1.5
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Riverside	.....	.....	.....	2.29	
Rockisland	83[e]	29	59.8	2.04	
Rockland	.....	.....	.....	4.42	
Rockport	73	36	59.5	0.55	
Runge	94[e]	24[e]	61.5[e]	1.07	
Sabinal	92	25	61.3	0.28	
Sabine	78	28	58.6	1.35	
San Marcos	88	23	57.0	1.55	
San Saba	96	18	54.6	2.83	
Santa Gertrudes Ranch	.....	.....	.....	1.09	
Sherman	82	25	53.4	1.41	1.0
Sonora	96	16	53.8	0.28	T.
Sugarland	83	33	60.8	1.15	
Sulphur Springs	85	26	52.8	1.49	
Temple *a*	86	23	52.2	2.12	
Temple *b*	88	25	54.1	1.77	
Tilden	98	16	60.0	0.33	
Trinity	85	24	59.0	2.17	
Tulia	88	6	46.1	0.09	
Tyler	81	26	52.0	4.77	
Victoria	90[e]	27[e]	62.2[e]	0.75	
Waco	89	27	54.0	2.99	
Waxahachie	88	23	50.7	1.55	
Weatherford	91	22	49.6	1.85	1.5
Wichita Falls	.....	.....	.....	0.45	1.0
Utah.					
Alpine	.....	.....	.....	0.82	5.5
Aneth	77	7	41.8	0.07	
Blackrock	71	—7	35.4	1.00	9.2
Bluecreek	48	7	32.6	1.12	3.5
Cailao	86	—5	36.8	0.83	12.8
Cisco	71	0	37.2	0.65	5.0
Corinne	61	—2	31.0	2.14	9.0
Coyoto	68	—13	33.0	0.08	0.2
Deseret	71	—10	35.0	0.97	12.0
Emery	67	8	33.0	T.	
Farmington	60	1	33.6	3.59	24.0
Fillmore	67	2	37.8	1.90	.....
Fort Duchesne	65[b]	4[b]	36.0[b]	0.01	T.
Frisco	63	7	38.1	0.64	.....
Garrison	68	0	38.4	1.49	11.0
Giles	70	—3	35.8	T.	T.
Government Creek	63	1	33.7	2.24	21.0
Green River	73	—4	32.0	0.35	T.
Grover	69	0	35.6	0.40	4.0
Heber	56	—20	28.6	3.09	15.5
Henefer	60	—26	27.9	3.17	22.3
Hite	81	18	45.4	0.60	.....
Huntsville	.....	.....	.....	3.97	21.0
Ibapah	64	—4	31.8	1.75	17.2
Kanab	70	.....	.....	1.00	.....
Kelton	51	4	29.4	3.70	3.7
Levan	58	—2	32.4	1.93	15.0
Loa	70	0	31.2	0.50	5.0
Logan	58	—1[e]	30.6	2.25	.....
Lund	78	—10	35.7	0.67	5.6
Manti	62	—6	33.2	1.13	6.3
Marysvale	67	—12	36.8	0.91	9.8
Meadowville	52	2	28.4	4.70	15.0
Millville	.....	.....	.....	3.12	.....
Minersville	71	—4	37.4	1.70	12.0
Moab	78	10	43.6	0.41	1.3
Monticello	80	4	37.4	0.09	1.0
Morgan	55	—20	29.4	2.96	19.5
Mount Nebo	64	—3	33.9	2.28	14.5
Mount Pleasant	64	—2	32.8	1.71	7.0
Ogden	62	5	33.6	2.79	12.6
Park City	55	—2	31.6	5.00	41.0
Parowan	66	2	36.4	1.46	12.2
Pinto	62	—17	35.3	1.91	1.1
Plateau	61	—20	32.4	1.61	12.3
Promontory[e,1]	51	4	30.1	0.15	1.5
Provo	64	—8	33.2	2.27	10.7
Ranch	62	2	32.6	2.63	.....
Richfield	70	2	39.4	0.20	1.5
Rockville	89	1	41.4	1.30	.....
St. George	81	10	42.6	1.33	.....
Salt Air	66	8	35.4	1.75	14.5
Scipio	65	—15	36.0	1.74	8.0
Snowville	53	—9	27.8	2.25	6.0
Soldier Summit	62	—19	24.4	1.30	1.2
Terrace	60	3	32.5	0.50	5.0
Thistle	60	—16	32.2	1.55	9.5
Tooele	63	7	36.1	2.10	.....
Tropic	67[b]	3[c]	33.6[c]	T.	.....
Wellington	68[e]	—8[c]	31.2[c]	0.02	.....
Woodruff	65	—21	25.8	1.65	9.0
Vermont.					
Burlington	42	—11	12.5	0.90	7.0
Cavendish	46	—11	14.7	1.11	10.7
Chelsea	46	—19	10.8	0.51	7.0
Cornwall	45	—18	11.2	2.49	21.0
Derby	48	—19	8.5	.....	.....
Enosburg Falls	47	—25	9.2	1.81	15.0
Jacksonville	47	—16	11.4	4.08	23.3
Manchester	48	—10	15.0	1.11	12.2
Morrisville	48	—21	10.8	1.16	12.4
Norwich	45	—23	12.4	1.61	13.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Vermont—Cont'd.	°	°	°	*Ins.*	*Ins.*
St. Johnsbury	44	−23	11.7	1.01	16.0
Wells	45	−18	12.0	2.11	16.0
Woodstock	51	−15	17.3	0.99	8.5
Virginia.					
Ashland	67	0	31.2	1.68	5.7
Barboursville	65	4	31.4	1.54	7.0
Bedford	62[f]	4	33.4[d]	.....	10.0
Bigstone Gap	66	5	37.0	2.44	3.0
Blacksburg	68	−3	29.3	2.04	4.5
Buckingham	65	0	34.8	2.11	6.0
Burkes Garden	60	1	29.0	2.62	4.0
Callaville	72	4	33.8	3.48	6.0
Charlottesville	71	5	31.8	1.32	5.0
Columbia	.....	.....	.....	2.30	6.0
Dale Enterprise	59	−3	27.4	1.56	7.0
Danville	.....	.....	.....	2.96	4.0
Elk Knob	65	8	34.9	3.28	2.5
Farmville	60	0	31.0	2.80	4.0
Fredericksburg	64	−6	30.4	1.92	2.5
Hampton	73	11	34.6	4.93	12.1
Hot Springs	64	−7	27.5	2.45	8.0
La Crosse	71	9	34.0	3.50	7.0
Lexington	63	−5	30.8	1.97	6.5
Marion	65[f]	5[f]	28.9[d]	1.60	
McDowell	64	−8	29.6	0.85	5.0
Mendota	.....	.....	.....	2.64	0.9
Mount Weather	58	−4	22.2	1.00	T.
Newport News	68	8	34.9	4.40	12.0
Petersburg	71	4	33.6	2.69	8.2
Quantico	60	−3	25.7	.....	.....
Radford	.....	.....	.....	0.56	5.0
Riverton	.....	.....	.....	0.81	.....
Roanoke	.....	.....	.....	1.75	4.5
Rockymount	57	−5	30.2	1.86	4.5
Saxe	70	−2	34.0	2.97	4.8
Shenandoah	.....	.....	.....	0.98	7.9
Speers Ferry	.....	.....	.....	3.22	2.0
Spottsville	72	−1	34.0	4.07	14.0
Stanardsville	63	−4	27.2	1.20	2.0
Staunton	60	3	30.9	1.50	6.0
Stephens City	64	1	27.4	1.22	3.5
Warsaw	66	3	30.9	2.09	5.0
Wilkerson	64	−4	30.6	2.26	5.5
Williamsburg	67[d]	5[d]	32.8[d]	2.10	10.0
Woodstock	61	−6	28.6	0.75	2.8
Wytheville	69	6	32.8	2.13	2.0
Washington.					
Aberdeen	52	24	38.8	15.47	9.0
Anacortes	.....	.....	.....	4.00	2.0
Ashford	.....	.....	.....	10.55	88.0
Blaine	59	9	36.6	5.89	10.4
Brinnon	48	27	37.0	17.72	31.8
Cedonia	42	9	30.0	2.59	24.8
Centralia	55	16	38.2	8.26	4.5
Cheney	49	3	30.8	1.69	10.0
Clearbrook	50	14	34.2	6.35	12.5
Clearwater	49	25	37.2	18.79	10.0
Cle Elum	53	4	28.3	4.80	41.0
Colfax	54	4	34.8	3.97	
Colville	46	1	29.5	3.49	26.0
Conconully	47	−11	25.8	2.56	25.9
Coupeville	52	19	40.6	3.75	5.0
Crescent	43	0	28.8	2.96	17.5
Danville	43	−10	27.2	1.42	17.2
Dayton	62	16	38.3	3.86	4.5
East Sound	51	10	37.7	4.36	T.
Ellensburg	46	2	27.6	2.37	18.5
Ephrata	49	10	29.4	0.98	10.0
Grandmound	54	11	38.0	12.42	7.4
Granite Falls	.....	.....	.....	7.03	9.2
Horseheaven	.....	.....	.....	1.76	5.5
Kennewick	58	14	38.1	1.43	4.3
Lacenter	55	27	37.9	11.01	10.0
Lakeside	47	9	28.8	2.87	32.0
Lind	50	10	34.1	2.14	10.0
Loomis	45	0	26.5	2.00	20.0
Mayfield	52	20	36.6	4.70	5.0
Mottinger Ranch	60	19	40.5	1.98	2.0
Mount Pleasant	54	27	38.7	9.75	12.0
Moxee	52	−3	30.6	3.36	31.9
Northport	43	1	27.8	3.25	32.5
Odessa	46[b]	7[m]	32.7[b]	0.75	0.8
Olga	50	20	38.9	4.45	4.0
Olympia	54	22	38.3	12.17	1.0
Pinehill	52	19	35.0	6.90	44.0
Pomeroy	62	17	38.0	2.80	6.2
Port Townsend	49	22	39.6	4.64	4.8
Pullman	50	17	32.6	3.12	19.1
Rattlesnake	42	−11	28.2	2.08	12.2
Republic	43	−15	25.6	2.56	24.0
Ritzville	.....	.....	.....	0.74	4.5
Ritzville (near)	.....	.....	.....	1.70	9.2
Rosalia	50	4	31.9	2.37	9.0
Sedro-Woolley	50	17	38.0	7.00	12.2
Silvana	54	16	37.7	5.20	6.5
Snohomish	53	25	39.0	5.77	4.5
Snoqualmie	53	25	38.1	.....	.....
Southbend	52	25	39.2	13.14	0.2
Washington—Cont'd.					
South Ellensburg	46	0	27.9	2.00	22.0
Sprague	.....	.....	.....	2.80	9.0
Sunnyside	53	14	34.0	1.73	16.8
Trinidad	50	8	31.4	2.15	21.5
Twisp	47	−13	22.8	3.75	37.5
Union	54	24	37.2	15.91	23.0
Usk	44	−1	28.9	6.26	54.8
Vancouver	58	28	40.4	9.13	2.0
Vashon	53	25	39.4	6.37	.....
Waterville	39	−10	22.2	3.15	31.5
Wenatchee (near)	49	1	29.1	3.73	41.0
Whatcom	54	15	38.3	4.31	8.5
Wilbur	41	−5	25.8	1.64	7.0
Zindel	64	15	39.9	1.83	5.5
West Virginia.					
Bayard	63	−9	24.2	2.74	.....
Bens Run	71	−3	27.6	2.87	7.0
Beverly	67	−9	27.3	4.27	18.0
Bluefield	64	1	32.6	0.99	5.5
Buckhannon	69	−5	29.4	3.92	12.0
Burlington	65	−5	25.0	1.95	6.5
Cairo	73	−9	28.4	2.43	4.0
Central	70	−7	28.6	1.92	8.8
Charleston	.....	.....	.....	2.63	4.4
Creston	60	−2	28.9	2.11	8.8
Cuba	72	−6	29.8	1.32	2.2
Doane	80	0	39.0	3.18	6.8
Elkhorn	66	3	35.1	2.22	1.5
Fairmont	.....	.....	.....	1.90	3.1
Glenville	68	−2	28.2	3.12	12.0
Grafton	66	−6	29.6	2.22	8.0
Green Sulphur Springs	68	0	31.3	1.87	10.0
Hamlin	74	10	39.2	.....	.....
Harpers Ferry	.....	.....	.....	1.42	2.8
Hinton	.....	.....	.....	2.26	8.0
Huntington	72	4	31.0	2.02	5.8
Leonard	56	−6	28.2	3.70	12.0
Lewisburg	62	−5	28.5	2.37	8.2
Lillydale	69	−1	32.3	2.10	6.2
Logan	75	5	37.4	4.25	10.0
Lost Creek	65	−10	29.4	3.37	6.5
Mannington	63	−9	28.0	1.83	2.3
Marlinton	61	−10	25.0	3.10	10.5
Martinsburg	63	−1	23.3	1.05	1.0
Moorefield	68	−5	28.0	1.03	6.2
Morgantown	62	−7	28.4	2.02	4.0
Moundsville	63	−7	27.9	1.07	7.5
New Cumberland	60	−7	25.0	1.82	5.0
New Martinsville	69	−2	29.7	1.93	4.6
Nuttallburg	70	10	38.9	1.40	7.0
Parsons	62	1	26.6	3.52	13.5
Philippi	70	−8	29.6	2.12	8.7
Pickens	69	−13	28.5	4.55	26.0
Point Pleasant	73	1	31.6	1.80	3.0
Powellton	70	−10	27.8	2.49	6.0
Princeton	65	0	32.4	3.60	6.0
Romney	63	−4	26.7	0.52	1.5
Rowlesburg	.....	.....	.....	3.16	10.2
Ryan	72	−5	31.3	2.30	11.6
Southside	73	5	33.0	1.96	7.8
Spencer	72	−2	32.1	2.85	11.5
Terra Alta	65	−22	26.2	1.64	.....
Uppertract	66	−4	28.8	1.42	10.8
Valley Fork	72	−1	32.4	2.88	14.0
Webster Springs	71	−3	32.6	2.88	14.8
Wellsburg	68	−8	23.0	2.16	6.2
Weston	.....	.....	.....	2.91	10.0
Wheeling *a*	.....	.....	.....	1.03	4.9
Wheeling *b*	62	0	29.0	2.86	11.0
Williamson	75	4	37.6	1.44	4.0
Wisconsin.					
Amherst	44	−25	5.2	1.20	12.0
Antigo	45	−22	6.7	1.15	11.5
Appleton	40	−15	3.2	1.48	20.1
Appleton Marsh	44	−25	7.4	1.48	9.5
Ashland	.....	.....	.....	1.08	.....
Barron	42	−34	3.7	1.40	14.0
Beloit	44	−10	13.5	0.83	7.0
Brodhead	49	−22	13.0	1.20	11.0
Burnett	45	−20	8.2	0.93	8.5
Butternut	33	−36	1.5	1.50	15.0
Chilton	40	−20	6.6	2.19	20.1
Citypoint [g]	35	−20	8.2	0.37	4.0
Darlington	56	−27	11.6	1.05	10.5
Dodgeville	45	−19	15.1	0.35	3.5
Downing	40	−35	1.9	0.65	6.5
Easton	45	−30	6.4	1.09	10.8
Eau Claire	36	−28	4.4	0.75	7.5
Florence	34	−30	2.6	2.10	21.0
Fond du Lac	43	−19	10.8	1.10	9.5
Grand Rapids	39	−34	3.0	0.77	8.0
Grand River Locks	.....	.....	.....	1.33	24.0
Grantsburg	35	−39	2.0	1.55	15.5
Hancock	40	−25	5.6	1.47	14.7
Harvey	43	−13	10.9	1.12	10.3
Hayward	32	−40	0.2	0.81	8.1
Hillsboro	46	−27	7.2	1.16	11.0
Koepenick	38	−30	4.2	1.90	18.0
Wisconsin—Cont'd.					
Lancaster	50	−18	12.0	0.60	7.0
Madison	40	−14	10.4	1.87	10.2
Manitowoc	42	−14	9.8	1.88	26.5
Meadow Valley	40	−28	5.0	0.62	8.5
Medford	40	−28	4.6	0.90	9.0
Menasha	.....	.....	.....	0.54	13.5
Minocqua	33	−33	1.8	0.96	16.0
Mount Horeb	48	−18	10.9	0.66	5.5
Neillsville	40	−34	3.0	1.20	12.0
New London	41	−22	5.9	1.20	18.0
Oconto	42	−21	6.4	3.15	31.5
Osceola	35	−47	1.4	0.88	22.5
Oshkosh	41	−19	7.0	1.51	16.0
Pine River	44	−22	7.2	0.94	14.9
Portage	46	−17	10.2	0.65	12.0
Port Washington	42	−18	8.7	1.55	14.5
Prairie du Chien *a*	54	−21	14.4	0.66	8.4
Prairie du Chien *b*	.....	.....	.....	0.54	7.5
Prentice	33	−40	2.5	1.10	12.0
Racine	45	−12	14.0	0.84	8.4
Sheboygan	39	−12	11.2	2.70	27.0
Spooner	34	−38	1.0	0.94	9.4
Stanley	40	−31	5.4	0.92	9.9
Stevens Point	40	−36	5.0	0.98	10.2
Valley Junction	40	−27	9.8	0.46	6.0
Viroqua	41	−20	10.2	0.97	10.2
Washburn	35[f]	−23[f]	3.8[f]	1.30	13.0
Watertown	42	−18	10.4	1.09	10.8
Waukesha	41	−14	11.6	0.86	7.0
Waupaca	39	−23	5.2	1.10	17.5
Wausau	36	−26	6.1	1.57	.....
Whitehall	40	−29	4.9	0.88	8.8
Wyoming.					
Afton	55	−18	25.1	2.17	10.0
Alcova	58	−2	32.8	0.17	4.5
Basin	63	−11	27.8	T.	T.
Battle	35	−12	16.6	6.10	61.0
Bedford	46	−23	23.4	2.56	14.8
Border	48	−33	18.6	2.63	23.3
Buffalo	57	−18	21.0	1.35	13.5
Burlington	58	−10	24.6	0.45	4.5
Chugwater	69	0	35.4	0.55	5.5
Daniel	43	−27	15.6	1.55	15.5
Evanston	49	−20	25.3	1.56	11.0
Fort Laramie	45	−19	23.6	1.13	11.3
Fort Washakie	69	−15	29.7	0.22	1.9
Fourbear	60	−5	31.0	0.20	2.0
Griggs	53	−1	28.7	0.54	11.5
Hyattville	60	−20	26.3	1.08	11.1
Laramie	70	−10	28.4	.....	.....
Leo	56	−3	29.7	0.11	1.5
Lolabama Ranch	59	−9	26.4	0.86	7.9
Lusk	47	−3	24.9	0.41	5.5
Marquette	65	−15	27.2	0.12	1.2
Moore	73	−6	31.0	0.45	2.0
Moorcroft	61	2	33.6	0.51	5.9
Phillips	52	−20	20.0	1.60	16.0
Pine Bluff	67	−8	34.7	T.	T.
Rawlins [f]	69	−10	31.0	0.20	2.0
Thayne	58	0	31.8	0.47	3.5
Wells	49	−23	23.6	2.99	8.3
Yellowstone Pk. (G.Can.)	35	−24	16.2	3.67	42.6
Yellowstone Pk. (Lake)	38	−26	17.2	4.10	41.0
Yellowstone Pk. (L. basin)	48	−26	19.0	2.48	24.8
Porto Rico.	42	−16	19.8	3.32	45.2
Adjuntas	88	48	69.1	1.91	
Aguirre	90	59	77.0	0.74	
Arecibo	87	52	70.4	8.53	
Barros	83	48	69.5	4.58	
Bayamon	92	60	76.3	2.56	
Caguas	89	50	72.6	3.33	
Canovanas	87	66	76.2	4.80	
Cayey	92	49	72.0	2.74	
Cidra	86	49	70.1	12.70	
Coamo	89	48	72.0	0.06	
Corozal [f]	88	50	67.0	9.15	
Fajardo	87	61	76.6	3.80	
Guanica	88	57	73.1	1.87	
Hacienda Colosa	87	60	73.8	3.38	
Hacienda Josefa	.....	.....	.....	1.23	
Hacienda Perla	90	63	75.8	8.33	
Humacao	85	68	77.2	5.70	
Isabela	84	60	73.1	7.40	
Juan Diaz	89	61	76.2	0.19	
La Carmelita	85	59	71.2	2.58	
La Isolina	85	59	72.0	7.33	
Lares	86	53	70.0	3.90	
Las Marias	90	61	75.4	1.37	
Manati	91	60	74.0	6.56	
Maunabo	91	62	77.4	6.01	
Mayaguez	88	57	74.0	3.05	
Morovis	84	58	70.6	9.41	
Ponce	89	61	75.3	1.72	
Rio Blanco	88	60	75.9	7.44	
Rio Piedras	.....	.....	.....	5.23	
San German	91	58	75.1	5.60	
San Lorenzo	88	53	71.2	3.34	

TABLE II.—*Climatological record of voluntary and other cooperating observers. Late reports for January*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Porto Rico—Cont'd.	°	°	°	*Ins.*	*Ins.*
San Salvador	82	57	69.7	2.80	
Santa Isabel	88	59	74.9	0.61	
Vieques	88	60	73.7	1.29	
Yauco	85	60	73.2	3.70	
Mexico.					
Coatzacoalcos	85	54	71.2	3.32	
Durango	79	25	56.6	0.00	
Leon de Aldamas	81	33	59.7	0.02	
New Brunswick.					
St. John	39	—16	14.0	3.44	16.1
Isthmus of Panama.					
Alhajuela	95	70	83.5	0.75	
Bohio	.....	.....	.....	3.43	
Colon	.....	.....	.....	0.47	
Gamboa	.....	.....	.....	0.24	
La Boca	88	71	80.0	0.35	
West Indies.					
Columbia, Isle of Pines	84	55	71.5	0.56	
Late reports for January, 1904.					
Alaska.					
Coal Harbor	39	8	26.2	2.00	5.0
Alaska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fort Gibbon	20	—53	—19.1	0.08	3.5
Fort Yukon	.....	—61	.....	0.69	6.9
Kenai	35	—34	4.8	0.46	9.5
Sunrise	40	—21	11.5	1.69	20.6
Wood Island	52	8	28.5	3.63	15.0
Colorado.					
Lay	.....	—20	.....	0.68	10.5
Indiana.					
Mount Vernon	55	— 9	28.2	3.37	.....
Louisiana.					
Calhoun	72[c]	11[b]	43.4[c]	2.00	2.0
Michigan.					
Montague	36	—10	15.9	1.90	19.0
New Hampshire.					
Jefferson Highlands	.....	.....	.....	2.58	24.0
New Jersey.					
Englewood	57	—28	22.4	4.20	19.5
Layton	39	—30	15.4	3.21	25.5
North Carolina.					
Brewers	66	2	32.4	2.50	9.0
North Dakota.					
Wahpeton	37	—35	7.0	0.37	3.7

EXPLANATION OF SIGNS.

•Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance "*a*" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

NOTE.—The following change has been made in the names of stations; Arkansas, Rosadale, changed to Howe.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of February, 1904.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	29	6	7	27	n. 41 w.	30
Portland, Me	26	13	2	29	n. 64 w.	30
Concord, N. H.†	13	3	1	16	n. 56 w.	18
Northfield, Vt	33	20	4	9	n. 21 w.	14
Boston, Mass	19	11	5	32	n. 73 w.	28
Nantucket, Mass	22	12	4	32	n. 70 w.	30
Block Island, R. I	26	10	6	29	n. 55 w.	28
Narragansett, R. I.*	11	7	5	13	n. 63 w.	9
New Haven, Conn	33	10	6	20	n. 31 w.	27
Middle Atlantic States.						
Albany, N. Y	31	14	8	18	n. 30 w.	20
Binghamton, N. Y.†	12	4	6	12	n. 37 w.	10
New York, N. Y	24	12	9	27	n. 56 w.	22
Harrisburg, Pa	25	9	12	23	n. 34 w.	19
Philadelphia, Pa	26	16	8	25	n. 60 w.	20
Scranton, Pa	25	18	8	24	n. 66 w.	18
Atlantic City, N. J	29	11	5	27	n. 51 w.	28
Cape May, N. J	30	11	8	20	n. 32 w.	22
Baltimore, Md	24	14	12	24	n. 50 w.	16
Washington, D. C	25	14	11	18	n. 32 w.	13
Cape Henry, Va.†	16	10	4	6	n. 18 w.	6
Lynchburg, Va	22	13	14	26	n. 53 w.	15
Norfolk, Va	29	16	12	11	n. 18 e.	3
Richmond, Va	29	18	9	13	n. 20 w.	12
Wytheville, Va	8	6	18	32	n. 82 w.	14
South Atlantic States.						
Asheville, N. C	19	19	17	20	w.	3
Charlotte, N. C	21	17	17	18	n. 14 w.	4
Hatteras, N. C	32	8	15	16	n. 2 w.	24
Kittyhawk, N. C.*	14	7	8	9	n. 8 w.	7
Raleigh, N. C	26	15	15	18	n. 15 w.	11
Wilmington, N. C	24	11	16	18	n. 9 w.	13
Charleston, S. C	25	14	17	15	n. 10 e.	11
Columbia, S. C	11	7	10	7	n. 37 e.	5
Augusta, Ga	25	12	20	17	n. 13 e.	13
Savannah, Ga	21	15	17	17	n.	6
Jacksonville, Fla	26	13	19	12	n. 28 w.	15
Florida Peninsula.						
Jupiter, Fla	20	20	17	12	e.	5
Key West, Fla	20	9	38	3	n. 73 e.	37
Sand Key, Fla.†	11	6	19	2	n. 74 e.	18
Tampa, Fla	26	9	20	15	n. 16 e.	18
Eastern Gulf States.						
Atlanta, Ga	13	19	21	18	s. 27 e.	7
Macon, Ga.†	16	5	9	6	n. 15 e.	11
Pensacola, Fla.†	11	8	12	5	n. 67 e.	8
Birmingham, Ala.†	9	9	9	6	e.	3
Mobile, Ala	21	25	12	4	s. 58 e.	9
Montgomery, Ala	17	18	26	8	s. 87 w.	18
Meridian, Miss.†	12	8	11	4	n. 60 e.	8
Vicksburg, Miss	15	21	25	8	s. 71 e.	18
New Orleans, La	15	27	18	10	s. 34 e.	14
Western Gulf States.						
Shreveport, La	17	26	22	5	s. 62 e.	19
Fort Smith, Ark	18	8	30	7	n. 67 e.	25
Little Rock, Ark	23	15	19	12	n. 41 e.	11
Corpus Christi, Tex	14	27	23	2	s. 59 e.	25
Fort Worth, Tex	22	23	18	7	s. 85 e.	11
Galveston, Tex	12	31	21	4	s. 42 e.	26
Palestine, Tex	19	16	16	8	n. 69 e.	8
San Antonio, Tex	18	26	27	7	s. 68 e.	22
Taylor, Tex.†	11	15	3	5	s. 27 w.	4
Ohio Valley and Tennessee.						
Chattanooga, Tenn	18	21	18	9	s. 72 e.	10
Knoxville, Tenn	28	12	12	19	n. 24 w.	18
Memphis, Tenn	23	18	21	9	n. 67 e.	13
Nashville, Tenn	23	18	14	14	n.	5
Lexington, Ky.†	10	9	7	7	n.	1
Louisville, Ky	16	16	16	21	w.	5
Evansville, Ind.†	12	10	10	6	n. 63 e.	4
Indianapolis, Ind	22	17	11	17	n. 50 w.	8
Cincinnati, Ohio	17	15	17	23	n. 72 w.	6
Columbus, Ohio	15	19	20	16	s. 45 e.	6
Pittsburg, Pa	23	21	12	15	n. 56 w.	4
Parkersburg, W. Va	21	16	15	21	n. 50 w.	8
Elkins, W. Va	12	13	3	37	s. 88 w.	34
Lower Lake Region.						
Buffalo, N. Y	10	12	13	32	s. 84 w.	19
Oswego, N. Y	19	21	12	21	s. 77 w.	9
Rochester, N. Y	8	17	9	35	s. 71 w.	28
Syracuse, N. Y	9	16	10	33	s. 73 w.	24
Erie, Pa	21	14	15	17	n. 16 w.	7
Cleveland, Ohio	19	22	11	20	s. 72 w.	10
Sandusky, Ohio†	8	10	5	13	s. 76 w.	8
Toledo, Ohio	18	16	15	23	n. 76 w.	8
Detroit, Mich	19	14	19	20	n. 11 w.	5
Upper Lake Region.						
Alpena, Mich	18	10	12	30	n. 66 w.	20
Escanaba, Mich	29	13	11	20	n. 29 w.	18
Grand Rapids, Mich	21	16	22	14	n. 58 e.	9
Houghton, Mich.†	11	2	7	15	n. 42 w.	12
Marquette, Mich	18	12	11	29	n. 72 w.	19
Port Huron, Mich	21	17	15	24	n. 66 w.	10
Sault Ste. Marie, Mich	18	9	15	29	n. 57 w.	17
Chicago, Ill	21	14	19	18	n. 8 e.	7
Milwaukee, Wis	22	12	15	20	n. 27 w.	11
Green Bay, Wis	20	19	13	17	n. 76 w.	4
Duluth, Minn	26	7	15	25	n. 28 w.	22
North Dakota.						
Moorhead, Minn	25	16	17	15	n. 13 e.	9
Bismarck, N. Dak	21	13	25	9	n. 63 e.	18
North Dakota—Continued.						
Williston, N. Dk.	13	11	25	15	n. 79 e.	10
Upper Mississippi Valley.						
Minneapolis, Minn.*	13	5	10	11	n. 7 w.	8
St. Paul, Minn	26	10	19	20	n. 3 w.	16
La Crosse, Wis †	12	10	4	7	n. 56 w.	4
Davenport, Iowa	21	11	23	15	n. 61 e.	21
Des Moines, Iowa	24	14	20	17	n. 17 e.	10
Dubuque, Iowa	25	11	18	20	n. 8 w.	14
Keokuk, Iowa	27	13	16	15	n. 4 e.	14
Cairo, Ill	27	16	15	8	n. 32 e.	13
Springfield, Ill	22	15	18	16	n. 16 e.	7
Hannibal, Mo. †	11	6	9	10	n. 11 w.	5
St. Louis, Mo	19	17	24	9	n. 82 e.	15
Missouri Valley.						
Columbia, Mo. *	21	9	19	20	n. 5 w.	12
Kansas City, Mo	25	14	22	12	n. 42 e.	15
Springfield, Mo	21	19	24	10	n. 82 e.	14
Topeka, Kans.*	12	8	11	6	n. 51 e.	6
Lincoln, Nebr	25	17	21	7	n. 60 e.	16
Omaha, Nebr	28	17	16	9	n. 32 e.	13
Valentine, Nebr	22	13	18	14	n. 24 e.	10
Sioux City, Iowa †	12	9	9	6	n. 45 e.	4
Pierre, S. Dak	23	8	28	12	n. 47 e.	22
Huron, S. Dak	29	13	20	15	n. 17 e.	17
Yankton, S. Dak. †	13	7	8	10	n. 18 w.	6
Northern Slope.						
Havre, Mont	19	6	26	18	n. 32 e.	15
Miles City, Mont	29	16	16	9	n. 28 e.	15
Helena, Mont	10	21	3	38	s. 73 w.	37
Kalispell, Mont	7	15	2	38	s. 77 w.	37
Rapid City, S. Dak	19	9	17	23	n. 31 w.	12
Cheyenne, Wyo	10	23	3	33	s. 67 w.	33
Lander, Wyo	12	24	11	22	s. 43 w.	16
Yellowstone Park, Wyo.	3	39	2	30	s. 38 w.	46
North Platte, Nebr	19	20	18	13	s. 79 e.	5
Middle Slope.						
Denver, Colo	20	21	12	19	s. 82 w.	7
Pueblo, Colo	17	9	15	26	n. 54 w.	14
Concordia, Kans	22	19	20	9	n. 75 e.	11
Dodge, Kans	21	18	21	12	n. 72 e.	10
Wichita, Kans	23	17	26	2	n. 76 e.	25
Oklahoma, Okla	25	22	17	3	n. 78 e.	14
Southern Slope.						
Abilene, Tex	18	31	12	7	s. 21 e.	14
Amarillo, Tex	12	29	13	19	s. 19 w.	18
Southern Plateau.						
El Paso, Tex	18	6	14	34	n. 59 w.	23
Santa Fe, N. Mex	16	21	16	19	s. 31 w.	6
Flagstaff, Ariz	16	13	6	33	n. 84 w.	27
Phoenix, Ariz	15	5	26	20	n. 31 e.	12
Yuma, Ariz	23	15	13	18	n. 32 w.	9
Independence, Cal	17	19	12	27	s. 82 w.	15
Middle Plateau.						
Carson City, Nev	8	32	9	25	s. 34 w.	29
Winnemucca, Nev	10	25	10	28	s. 50 w.	23
Modena, Utah	2	22	6	41	s. 60 w.	40
Salt Lake City, Utah	16	29	14	16	s. 9 w.	13
Grand Junction, Colo.	20	15	13	24	n. 66 w.	12
Northern Plateau.						
Baker City, Oreg.	9	34	23	14	s. 20 e.	27
Boise, Idaho	9	28	22	13	s. 25 e.	21
Lewiston, Idaho†.	3	5	19	7	s. 81 e.	12
Pocatello, Idaho	1	28	28	15	s. 26 e.	30
Spokane, Wash	2	35	17	12	s. 9 e.	33
Walla Walla, Wash	6	38	12	10	s. 4 e.	32
North Pacific Coast Region.						
North Head, Wash	6	30	20	16	s. 9 e.	24
Port Crescent, Wash*	4	10	15	5	s. 59 e.	12
Seattle, Wash	5	35	29	2	s. 42 e.	40
Tacoma, Wash	7	38	6	19	s. 23 w.	34
Tatoosh Island, Wash.	6	30	24	13	s. 25 e.	26
Portland, Oreg.	2	35	13	24	s. 18 w.	35
Roseburg, Oreg	6	28	15	23	s. 20 w.	23
Middle Pacific Coast Region.						
Eureka, Cal	7	35	18	12	s. 12 e.	29
Mount Tamalpais, Cal	15	23	7	28	s. 69 w.	22
Red Bluff, Cal	18	23	19	14	s. 45 e.	7
Sacramento, Cal	9	36	23	6	s. 33 e.	32
San Francisco, Cal	10	18	13	30	s. 65 w.	19
Point Reyes Light, Cal*	8	9	5	16	s. 85 w.	11
Southeast Farallon, Cal*	9	10	2	14	s. 85 w.	12
South Pacific Coast Region.						
Fresno, Cal	22	16	19	16	n. 27 e.	7
Los Angeles, Cal	14	15	15	27	s. 85 w.	12
San Diego, Cal	33	6	8	27	n. 35 w.	33
San Luis Obispo, Cal	25	15	5	17	n. 50 w.	16
West Indies						
Basseterre, St. Kitts, W. I.						
Bridgetown, Barbados						
Cienfuegos, Cuba						
Colon, Colombia, S. A.†						
Curaçoa, W. I.						
Grand Turk, W. I.†	3	3	26	0	e.	26
Hamilton, Bermuda	23	10	7	34	n. 64 w.	30
Havana, Cuba†	6	2	22	1	n. 79 e.	21
Kingston, Jamaica						
Port of Spain, Trinidad†						
Puerto Principe, Cuba						
Roseau, Dominica, W. I.†						
San Juan, Porto Rico	7	21	42	2	s. 71 e.	42
Santiago de Cuba, Cuba						

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, February, 1904.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	52	T.							15	2	6	5											2							1			31	6	T.
		A.																															0	0	A.
Arizona	56	T.																	1														1	1	T.
		A.																															0	0	A.
Arkansas	57	T.					1	9	12										2	9			1		1					3			38	8	T.
		A.																															0	0	A.
California	167	T.				2	1																			1	1	2		1			8	6	T.
		A.																															0	0	A.
Colorado	81	T.																															0	0	A.
		A.																															0	0	T.
Connecticut	21	T.							7																								7	1	T.
		A.																															0	0	A.
Delaware	5	T.																												2			2	1	T.
		A.																															0	0	A.
Dist. of Columbia	4	T.																															0	0	T.
		A.																															0	0	A.
Florida	47	T.								4		1	1							1	2	8	14	1									32	8	T.
		A.																															0	0	A.
Georgia	55	T.							17	5	7	4	1								1	1	1										37	8	T.
		A.																															0	0	A.
Idaho	34	T.								2					1																		3	2	T.
		A.																															0	0	A.
Illinois	92	T.						7	17																					2	16			42	4	T.
		A.																												1				1	1	A.
Indiana	58	T.					1	7	35																					5	12			60	5	T.
		A.																															0	0	A.
Indian Territory	11	T.					2		1											1													4	3	T.
		A.																															0	0	A.
Iowa	149	T.						5	1																						1		7	3	T.
		A.																															0	0	A.
Kansas	77	T.	1					6	3										1														11	4	T.
		A.		1																													1	1	A.
Kentucky	41	T.						2	20										1									1		1			25	5	T.
		A.								1									1		2		1										6	5	A.
Louisiana	46	T.					1		4	2	4	10							2	4		1											28	8	T.
		A.																															0	0	A.
Maine	19	T.						1	2																								3	2	T.
		A.					1								1																		2	2	A.
Maryland	48	T.																												13			13	1	T.
		A.																															0	0	A.
Massachusetts	48	T.																															0	0	T.
		A.																															0	0	A.
Michigan	106	T.							11	2								3												4	11			31	5	T.
		A.																															0	0	A.
Minnesota	67	T.																															0	0	T.
		A.																															0	0	A.
Mississippi	44	T.					1		7	2	9	7							1	3													30	7	T.
		A.																															0	0	A.
Missouri	95	T.						22	31	1		1							2	10										11			78	7	T.
		A.																															0	0	A.
Montana	40	T.																															0	0	T.
		A.																															0	0	A.
Nebraska	142	T.																					1	1		1							3	3	T.
		A.																															0	0	A.
Nevada	40	T.																2							1			1					4	3	T.
		A.																															0	0	A.
New Hampshire	19	T.																															0	0	T.
		A.					1																										1	1	A.
New Jersey	51	T.																												13			13	1	T.
		A.																															0	0	A.
New Mexico	31	T.																															0	0	T.
		A.																															0	0	A.
New York	99	T.	1				1	1	41																				1	31	17			93	7	T.
		A.																															0	0	A.
North Carolina	56	T.							28	1											1					2	16	8	2				58	7	T.
		A.																															0	0	A.
North Dakota	48	T.							1	1	1				2	1																	6	5	T.
		A.							73															2					33	46			154	4	A.
Ohio	128	T.																															0	0	T.
		A.						1																									1	1	A.
Oklahoma	23	T.																															0	0	T.
		A.				2						3	2	1	1		1							1	1	1	10	1	5				29	12	T.
Oregon	74	T.																															0	0	A.
		A.		1					33														1						28	10			73	5	T.
Pennsylvania	91	T.																															0	0	A.
		A.																															0	0	T.
Rhode Island	7	T.																															0	0	A.
		A.																															31	7	T.
South Carolina	46	T.						1	20	4	3	1																1	1				0	0	A.
		A.																															1	1	T.
South Dakota	56	T.																															8	6	A.
		A.		1								1	1		3							1					1						49	7	T.
Tennessee	56	T.							27			1					1		1								11	6		2			0	0	A.
		A.																															32	11	T.
Texas	95	T.				1	4	5	3		1	1						1	2	10	1	3											0	0	A.
		A.																															8	3	T.
Utah	47	T.																5	2		1												0	0	A.
		A.																															0	0	T.
Vermont	16	T.																															0	0	A.
		A.							12																			1	1	9			23	4	T.
Virginia	50	T.																															0	0	A.
		A.						1			1	3	1	1				1		1			4			1	1	1	2				18	12	T.
Washington	64	T.																															0	0	A.
		A.							26																					13	3			42	3	T.
West Virginia	43	T.																															0	0	A.
		A.																															0	0	T.
Wisconsin	60	T.													1																		1	1	A.
		A.																			1												2	2	T.
Wyoming	31	T.																					1										0	0	A.
		A.																																		
Sums	2893	T.	2	1	0	5	12	68	446	25	31	37	5	2	2	0	1	13	14	40	6	14	19	7	5	4	6	43	20	164	133			1,125		T.
		A.	0	2	0	0	2	0	1	2	1	1	1	0	7	1	0	1	1	0	2	0	1	1	0	0	0	1	0	1	0			25		A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during February, 1904, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	6			0.38														*			
Alpena, Mich.	21-22			0.57														*			
Amarillo, Tex	18			0.08														*			
Asheville, N. C.	26			0.66														0.50			
Atlanta, Ga.	7			0.50														0.43			
Atlantic City, N. J.	21-22			1.32														0.44			
Augusta, Ga.	7			0.46														0.31			
Baltimore, Md.	21-22			0.87														*			
Binghamton, N. Y.	7			0.41														*			
Birmingham, Ala	7			0.66														0.48			
Bismarck, N. Dak.	25			0.42														*			
Block Island, R. I.	21-22			1.59														*			
Boise, Idaho.	4			0.21														0.08			
Boston, Mass.	22			0.75														0.14			
Buffalo, N. Y.	29			1.07														*			
Cairo, Ill.	20-21			0.91														*			
Charleston, S. C.	20-22			1.79														0.57			
Charlotte, N. C.	26			0.52														0.35			
Chattanooga, Tenn.	7	8:10 a. m.	1:15 p. m.	0.62	11:23 a. m.	11:38 a. m.	0.02	0.35	0.51	0.56											
Chicago, Ill.	17-18			0.48														*			
Cincinnati, Ohio.	7			1.05														*			
Cleveland, Ohio.	29			0.57														0.26			
Columbia, Mo.	6-7			0.25														0.24			
Columbia, S. C.	7			0.53														0.33			
Columbus, Ohio.	7			0.62														0.58			
Concord, N. H.	14-15			0.70														*			
Corpus Christi, Tex.	10-11			0.88														0.38			
Davenport, Iowa.	17-18			0.31														*			
Denver, Colo.	17			0.17														*			
Des Moines, Iowa.	17			0.14														*			
Detroit, Mich.	29			1.16														0.38			
Dodge, Kans.	17			0.02																	
Dubuque, Iowa.	23			0.18														0.17			
Duluth, Minn.	5-7			0.41														*			
Eastport, Me.	1			0.96														0.18			
Elkins, W. Va.	7			0.54														0.25			
Erie, Pa.	29			1.32														*			
Escanaba, Mich.	13-14			0.55														0.06			
Evansville, Ind.	7	D. N.	D. N.	0.63	3:25 a. m.	3:43 a. m.	T.	0.15	0.31	0.38	0.45										
Fort Smith, Ark.	6			0.48														0.40			
Fort Worth, Tex.	4-5			1.46														0.20			
Galveston, Tex.	9			0.16									0.16								
Grand Junction, Colo.	16-17			0.27														0.08			
Grand Rapids, Mich.	5-6			0.53														*			
Green Bay, Wis.	29			0.31														*			
Harrisburg, Pa.	21-22			0.85														0.16			
Hatteras, N. C.	22			0.56														0.43			
Huron, S. Dak.	24-25			0.14														*			
Indianapolis, Ind.	7			1.10														*			
Jacksonville, Fla.	20-21			1.38														0.36			
Jupiter, Fla.	21			0.58														0.48			
Kalispell, Mont.	24			0.71														*			
Kansas City, Mo.	6			0.40														*			
Key West, Fla.	19			0.40														0.40			
Knoxville, Tenn.	7	9:50 a. m.	12:40 p. m.	1.26	9:55 a. m.	10:35 a. m.	0.01	0.06	0.26	0.55	0.59	0.65	0.72	0.77	0.84	0.86					
La Crosse, Wis.	17-18			0.20														*			
Lewiston, Idaho.	15-16			0.56														0.10			
Lexington, Ky.	7			1.20														*			
Lincoln, Nebr.	8			0.03																	
Little Rock, Ark.	18			1.70														0.44			
Los Angeles, Cal.	5			0.71														0.21			
Louisville, Ky.	7	D. N.	D. N.	0.77	4:02 a. m.	4:26 a. m.	0.02	0.07	0.18	0.22	0.27	0.51									
Lynchburg, Va.	21-22			0.97														0.18			
Macon, Ga.	10	2:35 a. m.	3:00 p. m.	1.47	9:41 a. m.	10:35 a. m.	0.27	0.06	0.12	0.22	0.26	0.28	0.36	0.45	0.56	0.66	0.73				
Memphis, Tenn.	20-21			0.65														0.15			
Meridian, Miss.	9-10			2.33														0.63			
Milwaukee, Wis.	17-18			0.42														*			
Montgomery, Ala.	5-6			1.50														0.48			
Nantucket, Mass.	22			1.01														0.45			
Nashville, Tenn.	7			0.25														0.25			
New Haven, Conn.	21-22			1.53														0.34			
New Orleans, La.	5-6			0.78														0.47			
New York, N. Y.	21-22			1.16														0.18			
Norfolk, Va.	21-22			0.74														0.44			
Northfield, Vt.	22			0.15														*			
North Head, Wash.	10			1.18														0.39			
Oklahoma, Okla.	20			0.04																	
Omaha, Nebr.	8-9			0.06														0.02			
Palestine, Tex.	19-20			1.12														0.60			
Parkersburg, W. Va.	7			0.41														0.23			
Pensacola, Fla.	10			0.59														0.33			
Philadelphia, Pa.	21-22			1.21														*			
Pittsburg, Pa.	23-24			0.72														*			
Pocatello, Idaho.	16			0.63														*			
Portland, Me.	21-22			0.78														0.16			
Portland, Oreg.	28-29			1.44														0.25			
Pueblo, Colo.	17-18			0.31														*			
Raleigh, N. C.	19			1.29														*			
Richmond, Va.	7			0.30														0.23			
Rochester, N. Y.	29			0.85														*			
Sacramento, Cal.	11-12			2.59														0.22			
St. Louis, Mo.	20-21			0.62														0.11			
St. Paul, Minn.	22-23			0.17														0.10			
Salt Lake City, Utah.	27-28			0.76														*			
San Antonio, Tex.	18-19			0.31														0.11			
San Diego, Cal.	5-6			0.48														0.27			
Sandusky, Ohio.	28-29			1.25														*			
San Francisco, Cal.	11-12			2.77														0.21			
Savannah, Ga.	21-22			0.61														0.29			
Scranton, Pa.	23-24			0.27														0.06			
Seattle, Wash.	3-4			0.53														0.15			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Shreveport, La	20–21			1.11														0.23			
Spokane, Wash	11–12			0.43														*			
Springfield, Ill	17			0.80														*			
Syracuse, N. Y	29			0.80														*			
Tampa, Fla	20	2:25 p. m.	7:15 p. m.	0.82	6:12 p. m.	6:27 p. m.	0.23	0.30	0.42	0.49	0.51										
Do	22	3:10 a. m.	6:50 a. m.	1.66	3:39 a. m.	5:09 a. m.	0.09	0.05	0.11	0.25	0.56	0.72	0.84	0.89	1.04	1.06	1.07	1.11	1.37	1.52	
Taylor, Tex	19–20			0.78														*			
Toledo, Ohio	28–29			1.66														*			
Topeka, Kans	17			0.13														*			
Valentine, Nebr	9–10			0.08														*			
Vicksburg, Miss	20–21			0.58														0.34			
Washington, D. C	21–22			0.88														0.18			
Wichita, Kans	17			0.02																	
Wilmington, N. C	21–22			0.88														0.18			
Wytheville, Va	7			0.56														*			
Yankton, S. Dak	17–18			0.21														*			
Havana, Cuba	12			0.60														0.57			
San Juan, Porto Rico	13	7:35 p. m.	11:40 p. m.	1.86	7:37 p. m.	7:57 p. m.	T.	0.10	0.32	0.51	0.58										

* Self register not working. † No precipitation during the month.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, February, 1904.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure, in inches. Sea level, reduced to mean of 24 hours.	Pressure, in inches. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Depth of snow.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.61	29.75	—.08	18.2	— 3.8	26.7	9.8	6.44	+1.53	27.0
Sydney, C. B. I	29.88	29.92	.00	14.1	— 5.2	24.1	4.1	4.54	+0.45	26.0
Halifax, N. S	29.84	29.95	.00	18.2	— 4.2	27.6	8.7	5.41	+0.25	31.3
Grand Manan, N. B	29.91	29.96	—.02	18.7	— 4.7	26.3	11.1	5.30	+1.33	32.5
Yarmouth, N. S	29.91	29.99	.00	21.4	— 4.4	28.4	14.4	5.57	+0.83	30.5
Charlottetown, P. E. I	29.89	29.93	—.02	11.1	— 6.5	21.0	1.2	2.79	—0.27	19.1
Chatham, N. B	29.91	29.94	—.02	8.0	— 4.5	21.2	— 5.3	2.64	—0.52	20.4
Father Point, Que	29.97	30.00	+.02	7.7	— 3.8	16.9	— 1.5	2.89	+0.68	28.9
Quebec, Que	29.71	30.05	+.06	6.9	— 4.9	14.4	— 0.7	3.24	—0.03	28.8
Montreal, Que	29.86	30.09	+.07	7.0	— 7.5	14.6	— 0.6	2.51	—0.56	21.5
Bissett, Ont	29.52	30.17	+.16	—0.4	—10.3	14.8	—15.5	1.12	—0.88	10.6
Ottawa, Ont	29.78	30.13	+.11	6.1	— 5.6	15.1	— 3.0	3.20	+0.51	22.0
Kingston, Ont	29.82	30.16	+.12	9.2	— 8.6	20.4	— 1.9	2.59	+0.05	12.9
Toronto, Ont	29.77	30.18	+.14	13.3	— 8.2	22.3	4.3	2.90	+0.29	18.7
White River, Ont	28.77	30.19	+.17	—8.0	— 8.2	8.5	—24.6	0.48	—1.04	4.7
Port Stanley, Ont	29.50	30.18	+.12	13.6	— 9.2	23.1	4.1	3.90	+0.69	13.9
Saugeen, Ont	29.42	30.17	+.15	8.6	—11.3	19.4	— 2.2	2.41	—0.49	22.7
Parry Sound, Ont	29.37	30.13	+.12	4.0	—10.3	16.6	— 8.6	2.20	—0.72	22.0
Port Arthur, Ont	29.47	30.24	+.19	0.5	— 5.9	10.6	— 9.7	0.18	—0.72	1.8
Winnipeg, Man	29.34	30.25	+.15	— 7.8	— 6.2	3.2	—18.9	0.85	—0.13	8.5
Minnedosa, Man	28.26	30.23	+.14	— 6.9	— 4.2	5.5	—19.3	0.77	+0.16	7.7
Qu'Appelle, Assin	27.80	30.23	+.15	— 7.6	— 7.0	1.7	—16.9	2.25	+1.52	22.5
Medicine Hat, Assin	27.67	30.10	+.05	— 0.3	—11.5	10.1	—10.7	0.67	0.00	6.7
Swift Current, Assin	27.38	30.14	+.07	— 3.1	—11.1	6.0	—12.1	0.76	+0.02	7.6
Calgary, Alberta	26.26	30.04	+.05	— 1.1	—14.6	8.0	—10.2	0.15	—0.48	1.5
Banff, Alberta	25.11	29.94	—.04	6.2	—13.0	16.2	— 3.9	1.73	+0.81	17.3
Edmonton, Alberta	27.66	30.14	+.12	— 8.3	—16.6	0.0	—16.6	1.96	+1.29	19.6
Prince Albert, Sask	28.49	30.18	+.07	—11.4	— 8.4	0.4	—23.3	1.24	+0.55	12.4
Battleford, Sask	28.32	30.21	+.12	—12.9	—13.0	—5.0	—20.8	1.78	+1.41	17.8
Kamloops, B. C										
Victoria, B. C	29.65	29.75	—.25	39.4	— 0.1	43.3	35.5	3.93	—0.17	5.3
Barkerville, B. C										
Hamilton, Bermuda	29.96	30.13	+.02	61.3	— 0.2	66.0	56.6	3.38	—1.06	

TABLE VII.—*Heights of rivers referred to zeros of gages, February, 1904.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn.[1]	1,954	14						
Red Wing, Minn.[1]	1,914	14						
Reeds Landing, Minn	1,884	12	2.2	1	1.1	20–29	1.3	1.1
La Crosse, Wis.[1]	1,819	12						
Prairie du Chien, Wis.[1]	1,759	18						
Dubuque, Iowa[1]	1,699	18						
Leclaire, Iowa[1]	1,609	10						
Davenport, Iowa[1]	1,593	15						
Muscatine, Iowa	1,562	16	7.5	10	4.2	3–5	5.1	3.3
Galland, Iowa[1]	1,472	8						
Keokuk, Iowa[1]	1,463	15						
Hannibal, Mo.[2]	1,402	13	9.3	13, 14	4.8	29		4.5
Grafton, Ill	1,306	23	9.2	15	6.5	6	7.7	2.7
St. Louis, Mo	1,264	30	10.5	15	6.2	4, 5	8.1	4.3
Chester, Ill	1,189	30	9.1	16	5.6	5	7.4	3.5
New Madrid, Mo	1,003	34	24.4	2	16.0	11	19.1	8.4
Memphis, Tenn	843	33	21.0	4	12.2	13	15.9	8.8
Helena, Ark	767	42	27.5	5	17.8	14	22.1	9.7
Arkansas City, Ark	635	42	29.4	7	21.7	16	25.3	7.7
Greenville, Miss	595	42	24.6	7	17.7	16, 17	20.8	6.9
Vicksburg, Miss	474	45	27.2	8	19.8	18	23.0	7.4
Natchez, Miss	373	46	26.9	10	17.7	1	23.2	9.2
Baton Rouge, La.[3]	240	35	18.6	10, 11	10.8	2	15.5	7.8
Donaldsonville, La	168	28	13.5	11	5.4	1	10.8	8.1
New Orleans, La	108	16	8.5	11, 12	3.8	1	7.0	4.7
James River.								
Huron, S. Dak.[1]	210	9						
Missouri River.								
Bismarck, N. Dak	1,309	14	1.6	17, 19	—0.9	8	0.5	2.5
Pierre, S. Dak.[1]	1,114	14						
Sioux City, Iowa[1]	784	19						
Omaha, Nebr.[1]	669	18						
St. Joseph, Mo	481	10	4.5	8	2.0	29	3.4	2.5
Missouri River—Cont'd.								
Kansas City, Mo	388	21	11.1	1, 3	6.1	24	8.0	5.0
Glasgow, Mo	231							
Boonville, Mo	199	20	7.9	11	5.2	3, 23	6.3	2.7
Hermann, Mo	103	24	7.1	11	4.7	23	5.9	2.4
Des Moines River.								
Des Moines, Iowa[1]	205	19						
Illinois River.								
Peoria, Ill	135	14	16.6	12	13.5	28	15.2	3.1
Allegheny River.								
Warren, Pa	177	14	11.4	8	1.1	23	3.6	10.3
Oil City, Pa	123	13	13.0	8	2.0	28	4.2	11.0
Parker, Pa	73	20	14.6	8	2.5	6	4.9	12.1
Freeport, Pa.[4]	29	20	20.8	8	4.5	19	7.9	16.3
Red Bank Creek.								
Brookville, Pa	35	8	3.8	8	1.0	1–7, 21–29	1.3	2.8
Clarion River.								
Clarion, Pa	32	10	9.8	8	1.6	6	3.1	8.2
Conemaugh River.								
Johnstown, Pa	64	7	7.0	7	1.6	21	3.0	5.4
Cheat River.								
Rowlesburg, W. Va.[5]	36	14	6.0	8	2.8	12		3.2
Youghiogheny River.								
Confluence, Pa.[6]	59	23	7.2	8	0.7	5, 6	2.3	6.5
West Newton, Pa.[7]	15	10	14.2	29	1.8	2	6.5	12.4
Monongahela River.								
Weston, W. Va	161	18	1.0	8, 29	—0.3	6	0.1	1.3
Fairmont, W. Va	119	25	20.4	8	14.7	4	15.8	5.7
Greensboro, Pa.[11]	81	18	14.5	8	7.4	5, 6, 18–21	8.8	7.1
Lock No. 4, Pa	40	28	17.0	9	6.8	6	9.2	10.2
Ohio River.								
Pittsburg, Pa	966	22	19.8	9	1.7	20	6.1	18.1
Davis Island Dam, Pa	960	25	18.9	8, 9	3.9	19	7.7	15.0
Beaver Dam, Pa	925	27	27.4	9	4.0	29	10.4	23.4

TABLE VII.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Ohio River—Cont'd.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Wheeling, W. Va	875	36	26.3	10	4.0	21	10.2	22.3
Parkersburg, W. Va	785	36	24.5	11	6.6	21, 22	11.3	17.9
Point Pleasant, W. Va	703	39	26.8	11	5.1	22	12.5	21.7
Huntington, W. Va	660	50	29.4	12	9.1	22	16.1	20.3
Catlettsburg, Ky	651	50	30.2	12	8.0	22	15.8	22.2
Portsmouth, Ohio	612	50	30.2	12	9.8	22	17.3	20.4
Cincinnati, Ohio	499	50	30.2	13	13.0	21	20.3	17.2
Madison, Ind	413	46	29.1	1	13.8	6	18.6	15.3
Louisville, Ky	367	28	11.4	1	6.4	21	8.3	5.0
Evansville, Ind	184	35	31.6	1	13.4	8	18.8	18.2
Paducah, Ky	47	40	25.3	1	13.5	9, 10	17.6	11.8
Cairo, Ill	1	45	30.2	2	19.6	10	23.5	10.6
Beaver River.								
Ellwood Junction, Pa.[8]	10	14	.....	.....	.....	.....	.....	.....
Muskingum River.								
Zanesville, Ohio	70	20	16.2	8	9.0	20, 21	11.1	7.2
Little Kanawha River.								
Glenville, W. Va	103	20	3.0	22, 28	—2.0	6, 7	0.9	5.0
New River.								
Radford, Va	155	14	3.3	23	0.8	2, 4, 5	1.6	2.5
Hinton, W. Va	95	14	5.0	23	1.2	5, 6	2.2	3.8
Great Kanawha, River.								
Charleston, W. Va	58	30	9.6	24	2.1	2	4.9	7.5
Scioto River.								
Columbus, Ohio[9]	110	17	12.2	8	5.4	1, 2	7.2	6.8
Licking River.								
Falmouth, Ky.[10]	30	25	8.0	8, 23	2.5	15	4.7	5.5
Miami River.								
Dayton, Ohio[2]	77	18	9.2	8	2.5	13	.....	6.7
Kentucky River.								
Beattyville, Ky	254	30	3.4	24	0.8	5	1.9	2.6
High Bridge, Ky	117	17	11.9	25	9.6	4, 5	10.5	2.3
Frankfort, Ky	65	31	8.0	25, 26	6.3	5, 6	7.1	1.7
Wabash River.								
Mount Carmel, Ill	50	15	19.1	14	6.8	21	13.1	12.3
Clinch River.								
Speers Ferry, Va	156	20	2.3	23	—0.6	3, 4	0.4	2.9
Clinton, Tenn	52	25	9.4	25	4.0	3–6	5.8	5.4
Holston River.								
Bluff City, Tenn	170	15	3.1	23	0.1	5	1.2	3.0
Rogersville, Tenn	103	14	3.8	23, 24	1.5	4–6	2.3	2.3
French Broad River.								
Asheville, N. C	144	6	1.6	22	—0.5	6, 17, 19	—0.1	2.1
Leadvale, Tenn	70	15	3.0	28	—0.3	19	0.9	3.3
Hiwassee River.								
Charleston, Tenn	18	22	6.5	23	0.9	17, 18	1.8	5.6
Tennessee River.								
Knoxville, Tenn	635	29	5.3	28	0.6	4–6	2.2	4.7
Kingston, Tenn	556	25	6.8	28	1.5	5–7	3.1	5.3
Chattanooga, Tenn	452	33	9.0	29	2.3	7	4.7	6.7
Bridgeport, Ala	402	24	6.4	29	1.4	6	3.2	5.0
Florence, Ala	255	16	5.5	28	1.3	8, 9	2.9	4.2
Riverton, Ala	225	25	6.8	28	1.3	8	3.3	5.5
Johnsonville, Tenn	95	21	7.4	29	3.2	9	4.6	4.2
Cumberland River.								
Burnside, Ky	518	50	6.5	28	2.4	6, 7	3.9	4.1
Celina, Tenn	383	45	8.6	26	3.3	7, 8	5.1	5.3
Carthage, Tenn	308	40	7.2	29	3.1	7, 8	4.5	4.1
Nashville, Tenn	193	40	10.2	29	4.9	8–10	6.4	5.3
Clarksville, Tenn	126	42	13.0	29	7.0	11	9.0	6.0
Arkansas River.								
Wichita, Kans	832	10	0.5	6	—0.1	9–12, 15, 16, 18, 19	0.1	0.6
Webbers Falls, Ind. T	465	23	3.9	1	2.9	24, 25, 27–29	3.3	1.0
Fort Smith, Ark	403	22	4.4	1	2.4	29	3.3	2.0
Dardanelle, Ark	256	21	5.6	1	2.9	18	3.7	2.7
Little Rock, Ark	176	23	8.4	24	4.3	16–18	6.1	4.1
White River.								
Newport, Ark	150	26	13.0	1	4.4	18	6.6	8.6
Yazoo River.								
Yazoo City, Miss	80	25	4.0	4–7	—0.1	19–26	1.6	4.1
Ouachita River.								
Camden, Ark	304	39	28.7	26	6.5	18	13.8	22.2
Monroe, La	122	40	14.3	29	3.6	21	8.2	10.7
Red River.								
Arthur City, Tex	688	27	5.2	1, 2	4.3	13–19	4.8	0.9
Fulton, Ark.[13]	515	28	.....	.....	.....	.....	.....	.....
Shreveport, La	327	29	8.9	28	0.8	21	3.3	8.1
Alexandria, La	118	33	8.1	29	1.4	18–20	3.4	6.7
Atchafalaya River.								
Melville, La	100	31	24.1	11	13.5	1	21.2	10.6
Penobscot River.								
Mattawamkeag, Me.[1]	87	.....	.....	.....	.....	.....	.....	.....
Montague, Me.[1]	60	.....	.....	.....	.....	.....	.....	.....
Kennebec River.								
Winslow, Me	46	.....	4.2	24, 26	0.5	28	3.0	3.7
Merrimac River.								
Franklin Junction, N. H.[1]	110	.....	.....	.....	.....	.....	.....	.....
Concord, N. H.[1]	94	.....	.....	.....	.....	.....	.....	.....
Manchester, N. H	68	.....	3.7	28	2.1	10	2.9	1.6
Connecticut River.								
Wells River, Vt.[1]	255	.....	.....	.....	.....	.....	.....	.....
White River Junction, Vt.[1]	209	.....	.....	.....	.....	.....	.....	.....
Bellows Falls, Vt	170	12	2.2	28	0.3	6	1.4	1.9
Holyoke, Mass	84	9	3.0	14	0.1	20	1.7	2.9
Hartford, Conn	50	13	6.1	25	3.1	8	4.1	3.0
Housatonic River.								
Gaylordsville, Conn[11]	50	15	8.5	8, 11	4.0	27	6.6	4.5
Mohawk River.								
Utica, N. Y	98	.....	8.5	10	1.6	4, 6, 19–21	3.2	6.9
Fort Hunter, N. Y	42	.....	22.0	11	7.0	1–7	14.8	15.0
Schenectady, N. Y	19	.....	6.0	9	1.6	5–8	2.5	4.4
Hudson River.								
Glens Falls, N. Y	197	.....	7.2	29	5.0	4, 5	6.1	2.2
Mechanicsville, N. Y	166	.....	3.0	8	0.4	5	1.5	2.6
Hudson River—Cont'd.								
Troy, N. Y	154	.....	12.1	9	4.5	6	3.6	7.6
Albany, N. Y	147	.....	6.9	9	2.0	26	7.0	4.9
Stuyvesant, N. Y	128	.....	3.0	8, 22	—0.6	17	1.3	3.6
Passaic River.								
Chatham, N. J.[7]	69	.....	7.9	24	3.4	3, 6	5.6	4.5
Pompton River.								
Pompton Plains, N. J.[12]	6	.....	.....	.....	.....	.....	.....	.....
East Branch Susquehanna.								
Binghamton, N. Y	306	16	11.6	9	2.9	6	5.4	8.7
Towanda, Pa	262	16	13.5	8	2.0	23	3.8	11.5
Wilkesbarre, Pa	183	17	25.7	10	10.6	6	14.9	15.1
West Branch Susquehanna.								
Lockhaven, Pa.[8]	65	12	.....	.....	.....	.....	.....	.....
Williamsport, Pa	39	20	14.0	8	2.4	6	3.9	11.6
Susquehanna River.								
Selinsgrove, Pa	116	17	8.6	10	2.0	6	3.6	6.6
Harrisburg, Pa	69	17	13.5	14	2.4	5	8.2	11.1
Juniata River.								
Huntingdon, Pa.[8]	90	24	9.0	8	3.7	28	.....	5.3
Shenandoah River.								
Riverton, Va	58	22	1.0	9	0.1	1–8	0.4	0.9
Potomac River.								
Cumberland, Md	290	8	4.8	7	2.8	21	3.5	2.0
Harpers Ferry, W. Va	172	18	5.4	10	0.2	6	2.5	5.2
James River.								
Lynchburg, Va	260	18	3.8	23	0.3	6, 7	1.8	3.5
Richmond, Va	111	12	1.7	24	—1.7	20	—0.4	3.4
Dan River.								
Danville, Va.[4]	55	8	2.2	23	0.0	19	0.5	2.2
Roanoke River.								
Clarksville, Va	196	12	8.9	23	3.6	29	4.9	5.3
Weldon, N. C	129	30	27.0	24	9.1	2	13.3	17.9
Cape Fear River.								
Fayetteville, N. C	112	38	34.0	24	5.5	1	13.2	28.5
Waccamaw River.								
Conway, S. C	40	7	4.6	27, 29	3.2	9, 10	3.8	1.4
Pedee River.								
Cheraw, S. C	149	27	25.7	23	2.8	1, 7, 18–20	7.3	22.9
Smiths Mills, S. C	51	16	13.5	29	6.7	9	9.0	6.8
Lynch Creek.								
Effingham, S. C	35	12	10.0	29	6.0	10, 11	7.7	4.0
Black River.								
Kingstree, S. C	52	12	10.0	26–28	7.5	1	8.6	2.5
Wateree River.								
Camden, S. C	45	24	23.6	23	6.2	1	10.1	17.4
Congaree River.								
Columbia, S. C	37	15	9.6	23	0.0	1–7	1.8	9.6
Santee River.								
St. Stephens, S. C	50	12	8.1	29	3.6	8, 9	6.0	4.5
Savannah River.								
Calhoun Falls, S. C	347	15	4.9	22	2.2	6, 7, 18	2.8	2.7
Augusta, Ga	268	32	17.8	23	7.5	5, 7	10.1	10.3
Broad River.								
Carlton, Ga	30	11	4.8	22	2.3	5, 6	2.9	2.5
Oconee River.								
Dublin, Ga	79	30	9.9	13–15	2.0	6, 7	5.6	7.9
Ocmulgee River.								
Macon, Ga	203	18	10.3	11, 23	3.1	6	5.7	7.2
Abbeville, Ga	96	11	11.8	13	5.1	7	8.8	6.7
Flint River.								
Woodbury, Ga	.....	.....	3.0	23	0.7	4, 6	1.7	2.3
Albany, Ga	80	20	17.9	13	5.3	6	10.3	12.6
Chattahoochee River.								
Oakdale, Ga	305	18	7.7	23	1.5	2, 4–6	2.6	6.2
Westpoint, Ga	239	20	6.4	23	2.8	4–6	4.0	3.6
Eufaula, Ala	90	40	25.7	11	3.8	5	9.7	21.0
Coosa River.								
Rome, Ga	271	30	7.7	23	1.2	4–6	2.9	6.5
Gadsden, Ga	144	22	7.9	25	0.8	3–6	3.1	7.1
Lock No. 4, Ala	116	17	6.5	25	1.2	6, 7	3.0	5.3
Wetumpka, Ala	6	45	16.2	11	4.8	5	9.4	11.4
Tallapoosa River.								
Milstead, Ala	38	35	13.8	11	2.9	1–5	6.0	10.9
Alabama River.								
Montgomery, Ala	265	35	15.2	12	2.8	3–6	7.3	12.4
Selma, Ala	212	35	21.5	13	3.5	6	10.0	18.0
Tombigbee River.								
Columbus, Miss	303	33	1.6	1	—1.2	18–20	—0.5	2.8
Demopolis, Ala	155	35	18.0	12	3.1	6	6.1	14.9
Black Warrior River.								
Tuscaloosa, Ala	90	43	12.1	12	6.2	6	7.6	5.9
Sabine River.								
Logansport, La	180	25	10.2	25	3.0	9, 16–18	5.2	7.2
Orange, Tex	10	7	— 1.4	1–7	—1.8	16–29	—1.6	0.4
Neches River.								
Rockland, Tex	110	20	8.2	21	1.3	1–9, 12, 13	3.2	6.9
Beaumont, Tex	40	10	1.5	29	—1.0	11	0.3	2.5
Trinity River.								
Dallas, Tex	330	25	7.2	6	2.0	27–29	2.8	5.2
Riverside, Tex	100	40	12.8	22	1.5	6, 7	5.0	11.3
Liberty, Tex	42	25	15.3	24, 25	4.3	11	7.4	11.0
Brazos River.								
Kopperl, Tex	369	21	0.2	8, 9, 23–29	—1.0	1–5	—0.1	1.2
Waco, Tex	301	24	4.1	7	2.2	1–4	2.7	1.9
Hempstead, Tex	215	40	3.0	21	—1.3	1–12	0.2	4.3
Booth, Tex	76	39	4.6	22	1.1	17	2.2	3.5
Colorado River.								
Ballinger, Tex	400	21	1.7	21	1.0	2–4, 6–17	1.2	0.7
Austin, Tex	214	18	2.7	9	1.2	1–7	1.6	1.5
Columbus, Tex	100	24	7.5	13	5.5	4–10	6.1	2.0
Red River of the North.								
Moorhead, Minn.[1]	418	26	.....	.....	.....	.....	.....	.....

TABLE VII.—*Heights of rivers referred to zeros of gages.*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Columbia River	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Umatilla, Oreg.	270	25	5.9	28	1.0	9	2.2	4.9
The Dalles, Oreg.	166	40	9.8	28	2.2	12	4.2	7.6
Willamette River.								
Albany, Oreg. [12]	118	20	24.7	17	4.9	5	11.6	19.8
Willamette River—Cont'd.								
Portland, Oreg.	12	15	13.0	18, 19	3.5	9, 10	8.2	9.5
Sacramento River.								
Red Bluff, Cal.	265	23	28.2	16	3.4	1–4	12.0	24.8
Sacramento, Cal.	64	25	27.9	26	12.8	4	19.2	15.1

[1] Frozen entire month. [2] Frozen for 15 days. [3] 28 days only. [4] Gorged for 12 days. [5] Frozen for 17 days. [6] Frozen for 4 days. [7] Frozen for 14 days. [8] Frozen for 25 days. [9] Frozen for 11 days. [10] Frozen for 12 days. [11] Frozen for 1 day. [12] Gage broken. [13] Record incomplete.

HAWAIIAN CLIMATOLOGICAL DATA.

By R. C. LYDECKER, Territorial Meteorologist.

Rainfall data for February, 1904.

Stations.	Elevation.	Amount.
HAWAII.		
HILO, e. and ne.	*Feet.*	*Inches.*
Waiakea	50	11.17
Hilo (town)		
Puueo	85	11.17
Kaumana	1,250	
Pepeekeo	100	8.59
Hakalau	200	8.79
Honohina	300	9.21
Puuohua	1,050	12.63
Laupahoehoe	500	7.80
Ookala	400	
HAMAKUA, ne.		
Kukaiau	250	9.86
Paauilo	300	10.28
Paauhau	300	7.85
Honokaa (Mill)	425	8.82
Honokaa (Meinicke)	1,100	
Kukuihaele	700	9.00
KOHALA, n.		
Awini Ranch	1,100	13.40
Halawa	450	14.05
Niulii	200	14.26
Kohala (Mission)	521	13.62
Kohala (Sugar Co.)	270	13.24
Hawi Mill	700	
Puakea Ranch	600	12.02
Puuhue Ranch	1,847	14.25
Waimea	2,720	9.68
KONA, w.		
Huehue	2,000	13.32
Holualoa	1,350	16.51
Kaukahoku Leheula	3,500	17.99
Kainaliu	1,470	14.25
Kealakekua	1,580	16.39
Napoopoo	25	10.15
Hoopuloa	1,650	7.29
Hoopuloa	2,300	10.00
Puuwaawaa Ranch	2,700	27.00
Huehue		
KAU, se.		
Kahuku Ranch	1,680	
Honuapo	15	13.75
Naalehu	650	13.91
Hilea	310	12.40
Pahala	850	
Moaula		
Volcano House	4,000	17.27
PUNA, e.		
Olaa, Mountain View (Russel)	1,530	11.17
Olaa Plantation (Mill)	210	14.45
Kapoho	110	20.40
Pahoa	600	18.32
MAUI.		
Lahaina		
Waiopae Ranch	700	17.58
Kaupo (Mokulau), s.	285	25.37
Kipahulu, s	308	23.87
Hana		
Nahiku, ne	850	15.52
Nahiku	1,600	18.09
Haiku, n	700	12.73
Kula (Erehwon), n.	4,500	21.45
Kula (Waiakoa), n.	2,700	15.59
Puuomalei, n.	1,400	13.00
MAUI—Continued.		
Paia	180	21.07
Haleakala Ranch	2,000	15.72
Wailuku, ne.	250	20.50
LANAI.		
Keomuku	10	19.73
OAHU.		
Punahou (W. B.), sw.	47	24.90
Kulaokahua (Castle), sw.	50	24.93
Makiki Reservoir	120	29.65
U. S. Naval Station, sw.	6	14.55
Kapiolani Park, sw.	10	22.72
College Hills	175	25.27
Manoa (Woodlawn Dairy), c.	285	27.83
Manoa (Rhodes Gardens)	360	31.11
Insane Asylum	30	23.15
School street (Bishop), sw.		
Kamehameha School		
Kalihi-Uka, sw.	485	30.30
Nuuanu (W. W. Hall), sw.	50	25.08
Nuuanu (Wyllie street)	250	24.23
Nuuanu (Elec. Station), sw.	405	22.51
Nuuanu (Luakaha), c.	850	27.96
U. S. Experiment Station	350	29.97
Kaliula	1,150	
Laniakea (Nahuina)		
Tantalus Heights (Frear)	1,360	30.76
Waimanalo, ne.	25	41.03
Maunawili, ne.	300	44.65
Kaneohe	100	26.28
Ahuimanu, ne.	350	38.09
Kahuku, n	25	36.82
Waialua		
Wahiawa	900	33.34
Ewa Plantation, s.	60	25.21
U. S. Magnetic Station		
Waipahu	200	30.04
Moanalua	15	20.12
Pacific Heights		
KAUAI.		
Lihue (Grove Farm), e.	200	22.38
Lihue (Molokoa), e.	300	21.37
Lihue (Kukaua), e.	1,000	25.46
Lihue (Kilohana)	400	22.16
Kealia, e.	15	21.43
Kilauea (Plantation), ne.	325	
Hanalei, n.	10	15.22
Waioli		
Haena		
Waiawa	32	17.28
Eleele	150	
Wahiawa (Mountain)	3,000	
McBryde (Residence)	850	23.51
Lawai (Gov. Road)	450	22.24
Lawai, w.	225	16.49
Lawai, e.	800	17.96
Koloa	100	77.18
Lawai Beach		19.81
Delayed January reports.		
U. S. Magnetic Station		0.95
Kahuku		1.94
Hoopuloa	1,650	4.50
Hoopuloa	2,300	5.96
Puuwaawaa Ranch		1.95
Paia plantation		9.29

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

GENERAL SUMMARY FOR FEBRUARY, 1904.

Honolulu.—Temperature mean for the month, 70.1°; normal, 70.2°; average daily maximum, 75.2°; average daily minimum, 65.2°; mean daily range, 10°; greatest daily range, 18° (4th); least daily range, 4° (17th); highest temperature, 79° (29th); lowest temperature, 55° (4th).

Barometer average, 29.892; normal, 29.966; highest, 30.07 (23d); lowest, 29.59 (11th); greatest 24-hour change, that is from any given hour of one day to the same hour on the next, .15; lows passed this point 6th to 20th and 26th to 29th, inclusive; highs, 23d.

Relative humidity average, 84.5 per cent; normal, 76.5 per cent; mean dew-point, 64.7°; normal, 62.3°; mean absolute moisture, 6.78 grains per cubic foot; normal, 6.24 grains.

Rainfall, 24.90 inches; normal, 5.51 inches; greatest rainfall in twenty-four hours 7.51 inches (from 9 a. m., 10th to 9 a. m., 11th); rain record days, 19; normal, 12; heaviest rainfall for

Meteorological Observations at Honolulu, February, 1904.

The station is at 21° 18′ north, 157° 50′ west. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.)

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

Rainfall for twenty-four hours is measured at 9 a. m. local, or 7:31 p. m., Greenwich time.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time.									
				Temperature.		Means.		Wind.			Sea-level pressures.		
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.	Average cloudiness.	Maximum.	Minimum.	Total rainfall at 9 a. m., local time.
	*	†	†			‡	‡		§				
1	29.95	67	60	74	63	61.7	81	sw.-ne.	0 4	8–3	29.99	29.91	0.04
2	30.00	66	63	74	66	57.3	66	ne.	4	1	30.02	29.96	0.00
3	29.95	57	55	73	63	58.0	73	nne.	2 0	5	30.03	29.95	0.00
4	29.90	56	54	73	57	56.0	77	nne.	2–0	2	29.98	29.89	0.00
5	29.98	63	61	73	55	54.0	73	sw.	1–0	1–5	29.95	29.89	0.00
6	29.89	69	65	76	60	59.0	74	sw.	0–1	3–7	30.03	29.94	0.01
7	29.88	63	62	76	65	66.0	87	se.	0–3	8–10	29.96	29.88	0.01
8	29.89	66	65.5	71	63	63.7	95	s.	1–0	10	29.96	29.86	6.22
9	29.92	70	68	73	65	66.3	93	s.	0	‖	29.96	29.86	1.32
10	29.83	67	65	76	67	68.7	91	s.	1–0	8–10	29.93	29.83	0.40
11	29.67	66	65.5	74	65	66.5	93	se.	2–0	10	29.83	29.68	2.30
12	29.62	68	66.5	75	65	67.5	90	s.-sw.	2–0	10–4	29.70	29.59	7.51
13	29.73	68	66	77	68	67.0	87	sw.	2–0	‖	29.73	29.62	0.26
14	29.73	71	70	76	68	67.3	85	sw.	1–0	6–9	29.79	29.73	0.10
15	29.84	69	68	74	69	67.5	94	ssw.	1–0	10	29.90	29.74	0.52
16	29.92	71	70.5	73	65	69.7	96	s.	0	10	29.96	29.82	1.43
17	29.85	72	71	75	66	71.3	94	s.	0	10	29.95	29.86	1.09
18	29.89	69	65.5	75	71	70.0	93	s.	0	10	29.91	29.81	0.20
19	29.80	74	72	77	65	66.7	84	se.–s.	3–0	10–8	29.89	29.75	0.78
20	29.89	68	67.5	75	67	68.3	92	s.-sw.	1–0	10–8	29.93	29.78	0.72
21	29.99	63	61.5	76	68	67.7	89	sw.	0	7	30.00	29.88	0.43
22	30.02	67	65	76	62	63.3	77	ne.	1	4	30.06	29.95	0.00
23	30.02	71	66	78	66	65.5	81	ne.	1	4	30.04	29.97	0.00
24	30.01	70	65	78	71	63.3	72	ne.	1	4–8	30.07	30.00	0.00
25	29.95	70	67	76	70	63.7	79	ne.–e.	2–0	4–10	30.04	29.97	0.00
26	29.91	67	65	78	68	65.3	81	ene.	0	7–4	29.99	29.90	0.06
27	29.89	65	64.5	78	65	66.7	83	se.–s.	0	8–10	29.95	29.87	0.00
28	29.91	64	63	75	65	65.0	88	s.-sw.	0	10–3	29.95	29.86	1.50
29	29.89	71	69	76	63	64.3	83	sw.	0	5–8	29.95	29.89	0.00
30													
31													
Sums													24.90
Means	29.887	67.2	65.1	75.2	65.2	64.7	84.5		0.7	6.9	29.947	29.850	
Departure.	—.074					+2.4	+8.0			+2.1			‖‖

Mean temperature for the month of February, 1904, (6 + 2 + 9) ÷ 3 = 70.1°; normal is 70.2°.
Mean pressure for the month of February, 1904, (9 + 3) ÷ 2 = 29.892; normal is 29.966.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4:31 p. m., Greenwich time. ‡ These values are the means of (6 + 9 + 2 + 9) ÷ 4. § Beaufort scale.

Maximum thermometer set at 9 p. m. and minimum at 2 p. m., local time.

‖ 10–4–10. ‖‖ 8–10–4. ‖‖‖ +19.39.

Oahu, at Maunawili, 44.65 inches; least, 14.55 inches at United States Naval Station.

The artesian well water level rose from 33.93 to 34.80 feet above mean sea level. February 28, 1903, it stood at 35.25. The average daily mean sea level for the month was 9.88, the assumed annual mean being 10 feet above datum. For February, 1903, it was 9.66.

Trade wind days, 8 (2 nne.); normal, 15; average force of wind, Beaufort scale and during daylight only, 0.7; average cloudiness, tenths of sky, 6.9; normal, 4.8.

Approximate percentages of district rainfall as compared with normal: Hawaii, Hilo district, 103 per cent; Hamakua, 130; Kohala, 325; Waimea, 210; Kona, 290; Kau, 486; Puna, 200; island of Maui—variable from 279 at Puuomalei to 871 at Paia; Oahu, Honolulu district, 452; Nuuanu, 303; Koolau, 610; Ewa, 733; island of Kauai—Lihue district, 453; Hanalei 155; Waiawea, 487 per cent.

The heaviest monthly rainfall was at Maunawili, Oahu, 44.65 inches. The heaviest 24-hour rainfalls were at Maunawili, 12.50 (11th); Pahoa, Hawaii, 11.00 (12th); Kahuku, 10.69 (11th).

Kohala, dew-point, 63.5°; relative humidity, 79.7 per cent.

Ewa Mill—Mean pressure, 29.85.

The month was characterized by heavy rains, especially on the island of Oahu, where the record was broken; low pressure, the barometer being below the normal for the first time in eight months; also by high relative humidity, dew-point and cloudiness, all of which were considerably above the normal. A marked feature of the storms was the light wind prevailing, the average force for the month being but 0.7 Beaufort scale.

Honolulu—Dew six mornings, and frequent thunder and lightning during the month.

Reported from other stations—Pepeekeo, Hawaii, dew twelve mornings; heavy surf 6th, 7th, 26th, and 27th; slight earthquake 19th at 1:05 a. m.; considerble thunder and lightning at intervals; snow on mountains all the month.

Waimea, Hawaii.—Lightning 1st and 4th to 9th, inclusive. Heavy thunder and lightning on 11th; generally cloudy weather; strong northwest gale 12th and 13th.

Hilo, Hawaii.—Earthquakes 14th at 1:33 p. m. (heavy), and 18th at 10:25 a. m.

Temperature table for February, 1904.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.	Highest.	Lowest.
	Feet.	°	°	°	°	°
Hilo	40	79.7	66.0	72.2	85	60
Pepeekeo	100	76.2	66.3	70.6	80	62
Olaa Mill	210	82.9	60.9	71.2	89	58
Kohala	521	76.2	64.1	69.5	83	60
Waimea	2,730	73.2	57.0	64.4	80	48
Volcano House	4,000	68.5	50.9	59.0	73	47
Waiakoa	2,700	73.5	57.9	65.0	81	53
Keomuku	10	78.5	70.4	74.1	.....	.....
Kinau	50	74.3	66.9	69.9	79	53
Ewa Plantation	.....	.....	.....	.....	.....	.....
United States Experiment Station	350	76.3	64.6	70.2	82	57

COSTA RICAN CLIMATOLOGICAL DATA.

Communicated by Mr. H. PITTIER, Director, Physico-Geographic Institute.

TABLE 1.—*Hourly observations at the Observatory, San José de Costa Rica, during February, 1904.*

Hours.	Pressure.		Temperature.		Relative humidity.		Rainfall.		
	Observed, 1904.	Normal, 1889–1903.	Observed, 1904.	Normal, 1889–1903.	Observed, 1904.	Normal, 1889–1903.	Observed, 1904.	Normal, 1889–1903.	Duration, 1904.
	Inches.	*Inches.*	° *F.*	° *F.*	%	%	*Ins.*	*Ins.*	*Hrs.*
1 a. m	26.18	26.16	60.8	61.9	82	82	.....	.....	.....
2 a. m	26.16	26.14	60.3	61.3	83	84	.....	.....	.....
3 a. m	26.13	26.13	60.0	60.9	81	84	.....	.....	.....
4 a. m	26.12	26.12	59.9	60.5	81	84	.....	T.	.....
5 a. m	26.12	26.12	59.4	60.4	81	83	.....	.....	.....
6 a. m	26.13	26.13	59.2	60.1	80	84	.....	T.	.....
7 a. m	26.15	26.15	59.2	60.1	81	84	.....	.....	.....
8 a. m	26.16	26.16	59.2	60.4	74	77	.....	.....	.....
9 a. m	26.17	26.17	65.9	66.7	66	69	.....	.....	.....
10 a. m	26.18	26.18	70.3	70.8	61	61	.....	.....	.....
11 a. m	26.18	26.18	73.0	71.6	53	57	.....	.....	.....
Noon	26.16	26.16	75.0	76.1	52	54	.....	.....	.....
1 p. m	26.15	26.14	76.1	77.5	54	53	0.05	T.	0.93
2 p. m	26.13	26.12	75.4	77.6	53	52	0.06	.....	1.66
3 p. m	26.11	26.10	74.9	76.8	54	54	0.05	T.	1.17
4 p. m	26.10	26.09	73.5	74.8	61	58	0.01	0.01	1.00
5 p. m	26.10	26.09	70.4	71.9	64	63	0.49	0.02	1.83
6 p. m	26.10	26.10	67.8	68.9	69	70	0.02	0.01	1.00
7 p. m	26.12	26.12	65.3	66.1	78	76	.....	0.01	.....
8 p. m	26.13	26.14	64.0	64.8	78	78	.....	0.01	.....
9 p. m	26.15	26.16	63.0	64.1	79	79	.....	0.04	.....
10 p. m	26.16	26.17	62.3	63.4	80	82	.....	0.02	.....
11 p. m	26.17	26.17	61.8	62.9	81	82	.....	.....	.....
Midnight	26.17	26.17	61.1	62.3	82	82	.....	.....	.....
Mean	26.14	26.14	65.7	67.0	71	72	.....	.....	.....
Minimum	26.03	25.96	52.9	46.8	36	.....	.....	.....	.....
Maximum	26.24	26.29	85.3	89.6	94	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	0.68	0.12	7.59

REMARKS.—At San José the barometer is 3,835 feet above sea level. Readings are corrected for gravity, temperature, and instrumental error. The hourly readings for pressure, and wet and dry bulb thermometers, are obtained by means of Richard registering instruments, checked by direct observations every three hours from 7 a. m. to 10 p. m. The thermometers are 5 feet above ground and are corrected for instrumental errors. The total hourly rainfall is as given by Hottinger's self-register, checked once a day. Under maximum, the greatest hourly rainfall for the month is given. The standard rain gage is 5 feet above ground. Since January 1, 1902, observations at San José have been made on seventy-fifth meridian time, which is 0 hours, 36 minutes, 13.3 seconds *in advance* of San José local time. The normals for pressure, temperature, and relative humidity have been adjusted to this time; the normal for rainfall in Table 1 and the sunshine observations and normal in Table 2 refer to local time. At Port Limon the hours of direct observation are 8 a. m., 2 and 8 p. m., San José local time; the barometer is 14 feet above sea level. The means for temperature and relative humidity in Table 4 are obtained from two-hourly readings given by a Richard self-registering thermometer.

TABLE 2.—*San José, February, 1904.*

Time.	Sunshine.		Cloudiness.		Temperature of the soil at depth of—				
	Observed, 1904.	Normal, 1889–1903.	Observed, 1904.	Normal, 1889–1903.	6 inches.	12 inches.	24 inches.	48 inches.	120 inches.
	Hours.	*Hours.*	%	%	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
7 a. m	11.57	9.73	27	34	70.2	70.7	71.1	69.7	69.6
8 a. m	25.29	22.64	.....	.....	.....	.....	.....	.....	.....
9 a. m	24.09	22.18	.....	.....	.....	.....	.....	.....	.....
10 a. m	22.26	21.32	46	40	70.6	70.6	71.1	69.8	.....
11 a. m	22.03	21.57	.....	.....	.....	.....	.....	.....	.....
Noon	19.76	21.34	.....	.....	.....	.....	.....	.....	.....
1 p. m	19.00	21.31	64	44	71.8	71.1	71.1	69.8	.....
2 p. m	19.80	21.92	.....	.....	.....	.....	.....	.....	.....
3 p. m	19.81	21.26	.....	.....	.....	.....	.....	.....	.....
4 p. m	15.00	19.06	71	54	72.6	71.5	71.2	69.7	.....
5 p. m	13.49	14.37	.....	.....	.....	.....	.....	.....	.....
6 p. m	5.19	4.05	.....	.....	.....	.....	.....	.....	.....
7 p. m	.....	.....	54	.....	72.7	71.8	71.2	69.7	.....
8 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
9 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
10 p. m	.....	.....	32	.....	72.0	71.5	71.2	69.7	.....
11 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
Midnight	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mean	.....	.....	50	.....	71.7	71.2	71.2	69.7	69.6
Total	217.29	220.73	.....	.....	.....	.....	.....	.....	.....

TABLE 3.—*Rainfall at stations in Costa Rica, February, 1904.*

Stations.	Height above sea level.	Observed, 1904.		Averages.		
		Amount.	Number of days.	Number of years.	Amount.	Number of days.
	Feet.	*Inches.*			*Inches.*	
Sipurio (Talamanca)	197	4.76	13	4	6.65	12
Boca Banano	10	8.50	21	8	6.26	15
Port Limon	10	.....	.....	10	5.39	11
Swamp Mouth	10	5.32	17	6	6.54	11
Zent	66	.....	.....	3	7.80	10
Siquirres	197	0.39	4	6	8.46	7
Dos Novillos	400	.....	.....	.....	.....	.....
Guapiles	984	2.48	12	4	6.06	9
Cariblanco (Sarapiquí)	2,740	.....	.....	6	7.99	18
San Carlos	528	3.43	11	6	6.14	11
Las Lomas	873	2.24	10	4	5.79	9
Peralta	1,089	5.20	11	6	5.24	11
Turrialba	2,034	.....	.....	9	1.73	10
Juan Viñas	3,412	2.13	7	8	3.90	6
Santiago	3,609	2.80	10	3	4.69	8
Paraiso	4,383	0.55	7	3	0.91	4
Cachi	3,346	.....	.....	3	4.09	9
Las Concavas	4,386	0.91	10	3	2.05	8
Cartago	4,761	.....	.....	3	0.98	7
Tres Rios	4,265	0.20	2	15	0.39	4
San Francisco Guadalupe	3,894	0.59	3	8	0.39	3
San José	3,806	0.68	4	15	0.24	2
La Verbena	3,740	0.16	3	8	0.24	2
Nuestro Amo	2,595	0.31	2	8	0.55	2
Alajuela	3,117	0.08	2	4	0.71	2
San Isidro Alajuela	4,416	0.47	3	3	3.27	2
Las Cañas	2,559	.....	.....	.....	.....	.....

Notes on the weather.—On the Pacific slope the rains were generally below the normal and the weather characteristic of the season. In San José pressure and relative humidity were about normal and temperature slightly below the average; the rainfall was about six times greater than usual, with great damage to coffee in preparation for the market. On the Atlantic slope the rains were almost invariably less than the average, except at Boca Banano, on the coast southeast from Limon.

Notes on earthquakes.—February 4, 6^h 14^m p. m., slight shock NW–SE., intensity IV, duration 8 seconds. February 7, 7^h 52^m a. m., slight shock NNW–SSE., intensity II, duration 3 seconds; 9^h 21^m p. m., almost imperceptible shock NNW–SSE., intensity I, duration 2 seconds; 9^h 31^m p. m., very slight shock N–S., intensity I, duration not ascertained. February 10, 4^h 34^m 21^s p. m., very slight shock NNE–SSW., intensity I, duration 1 second; 5^h 4^m p. m., very slight shock NNW–SSE., intensity I, duration not ascertained. February 13, 7^h 5^m a. m., very slight shock NNE–SSW., intensity I., duration 1 second.

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of Mr. H. H. Cousins, chemist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following table in advance of the regular monthly weather report for Jamaica:

Comparative table of rainfall for February, 1904.

[Based upon the average stations only.]

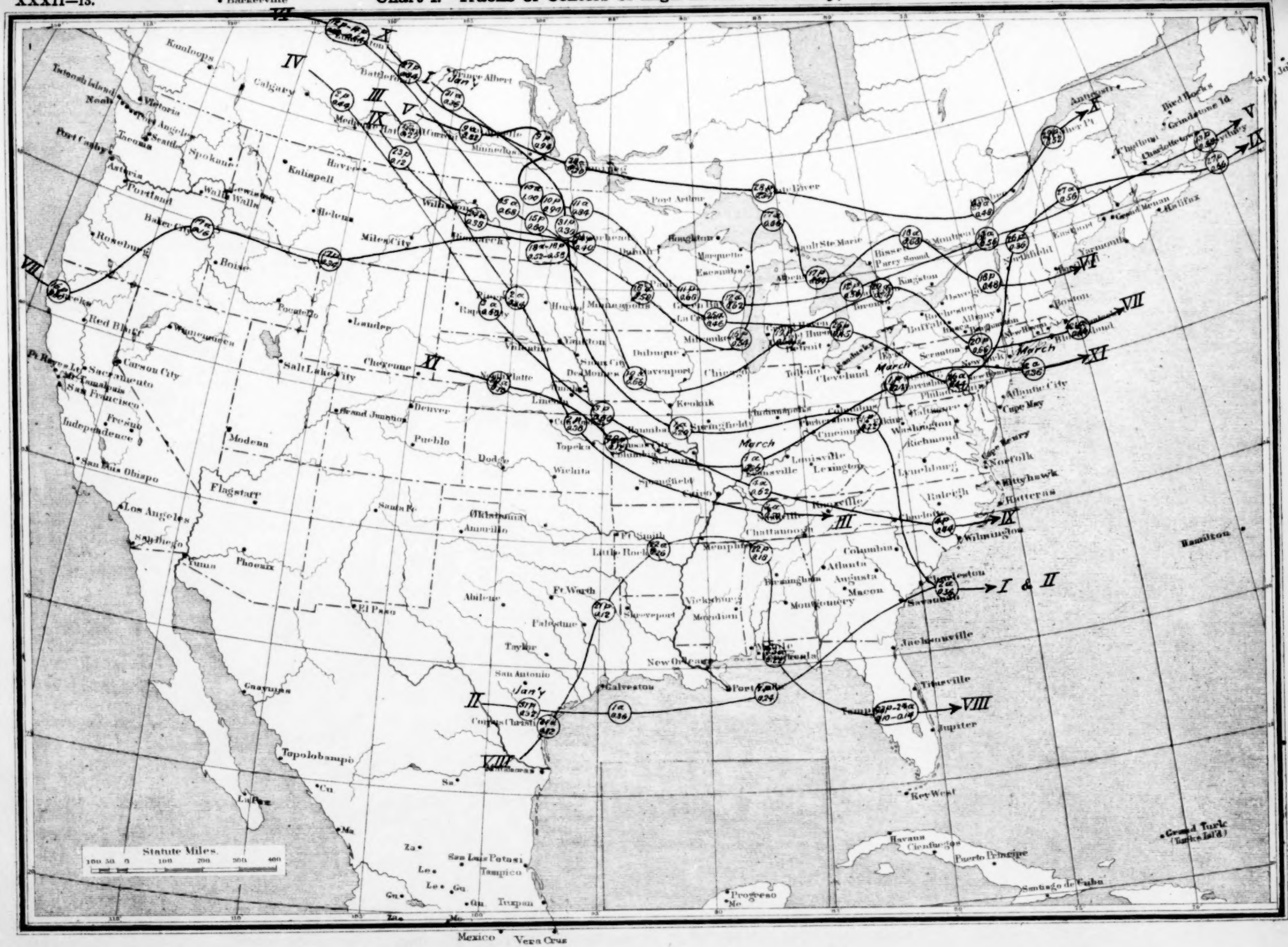
Divisions.	Relative area.	Number of stations.	Rainfall.	
			1904.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	24	8.45	4.73
Northern division	22	49	4.19	2.63
West-central division	26	24	3.13	2.44
Southern division	27	32	2.86	1.59
Means	100	291	4.66	2.85

The rainfall for February was, therefore, very much above the average for the whole island; the greatest fall, 30.91 inches, was recorded at Moore Town in the northeastern division, while 0.24 inch was recorded at Plum Point light-house in the southern division.

Chart I. Tracks of Centers of High Areas. February, 1904.

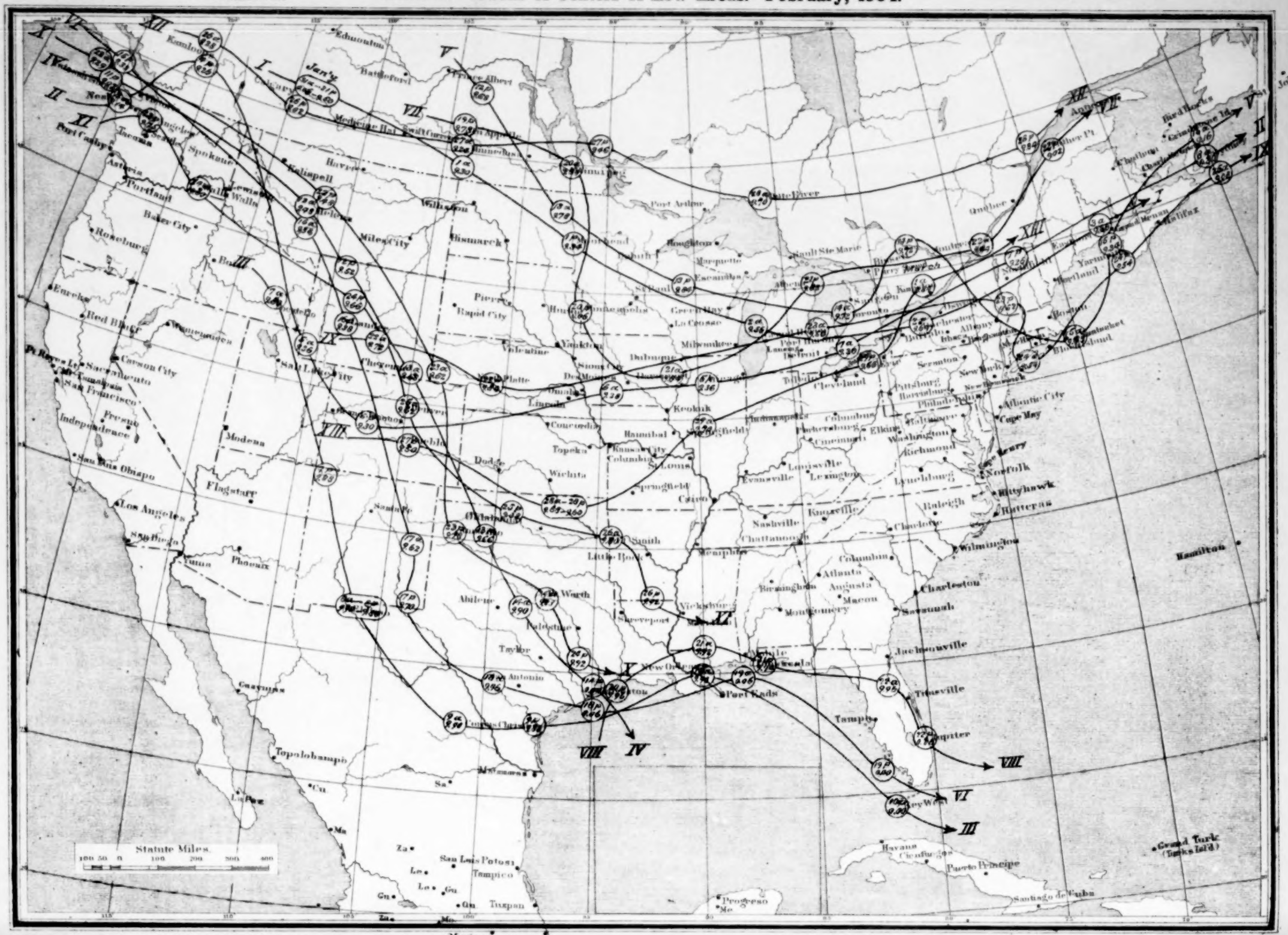
• Barkerville

Chart I. Tracks of Centers of High Areas. February, 1904.



XXXII—14. • Barkerville

Chart II. Tracks of Centers of Low Areas. February, 1904.



XXXII—15. • Barkerville

Chart III. Total Precipitation. February, 1904.

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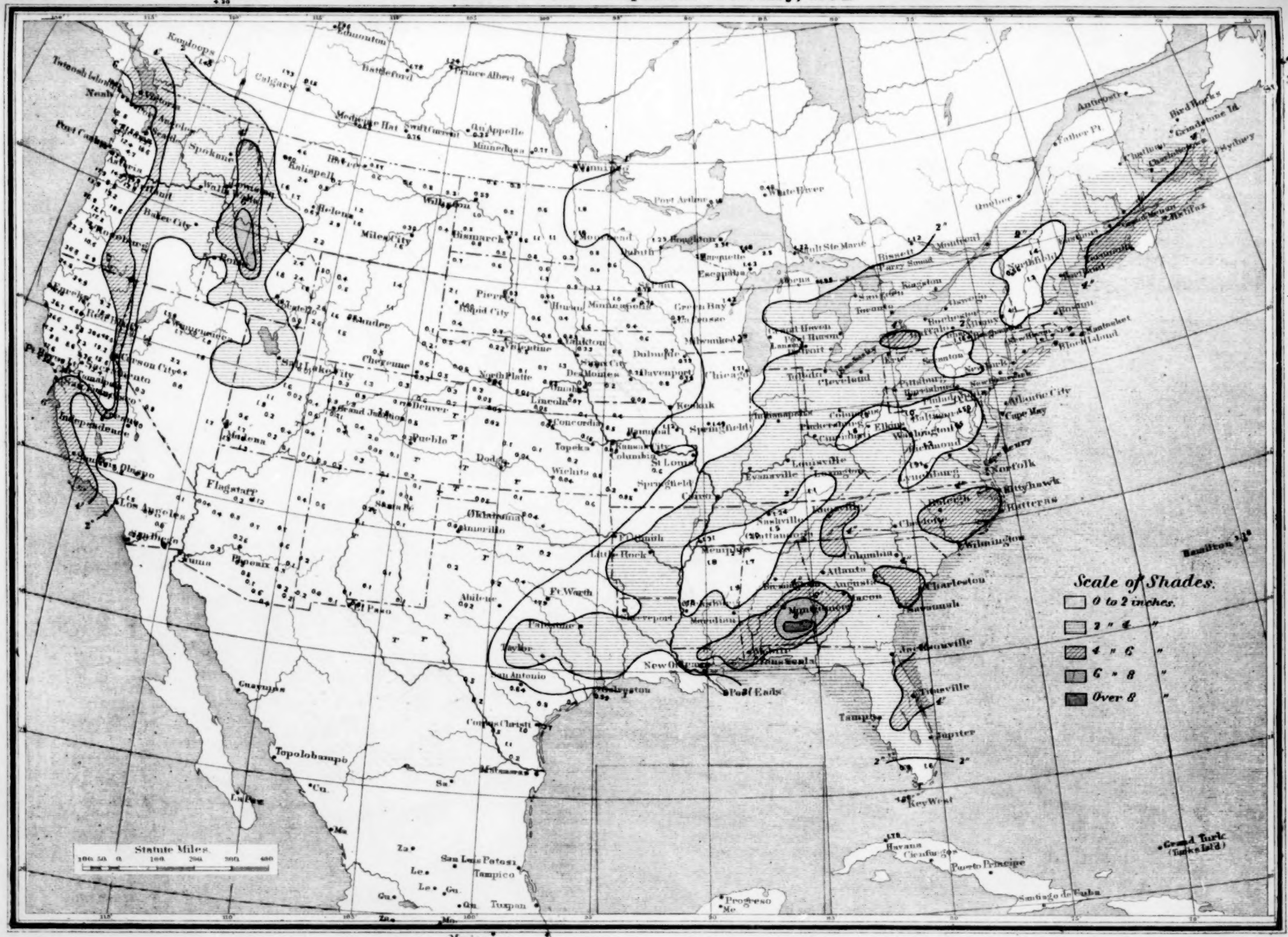
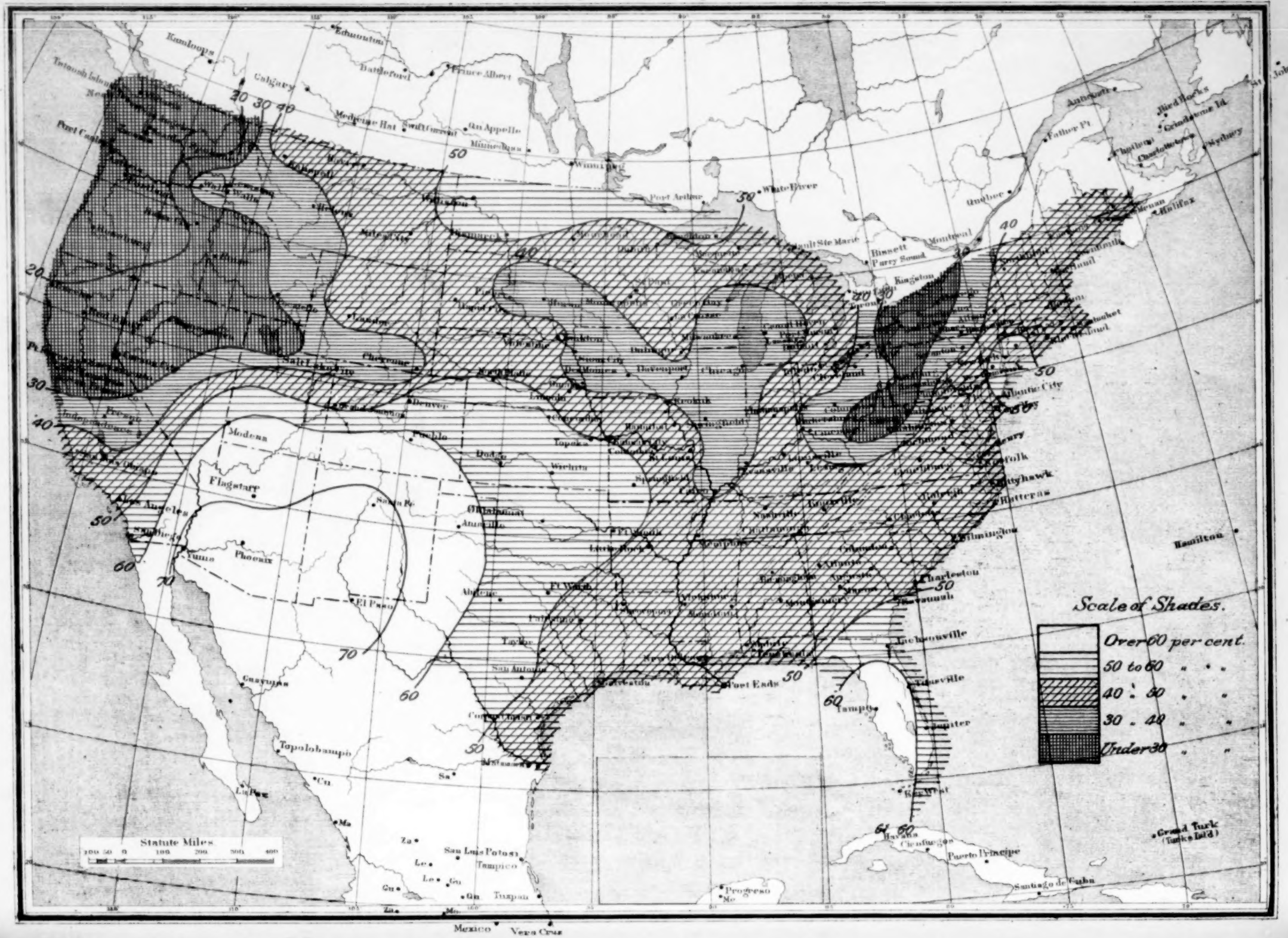


XXXII—16. • Barkerville

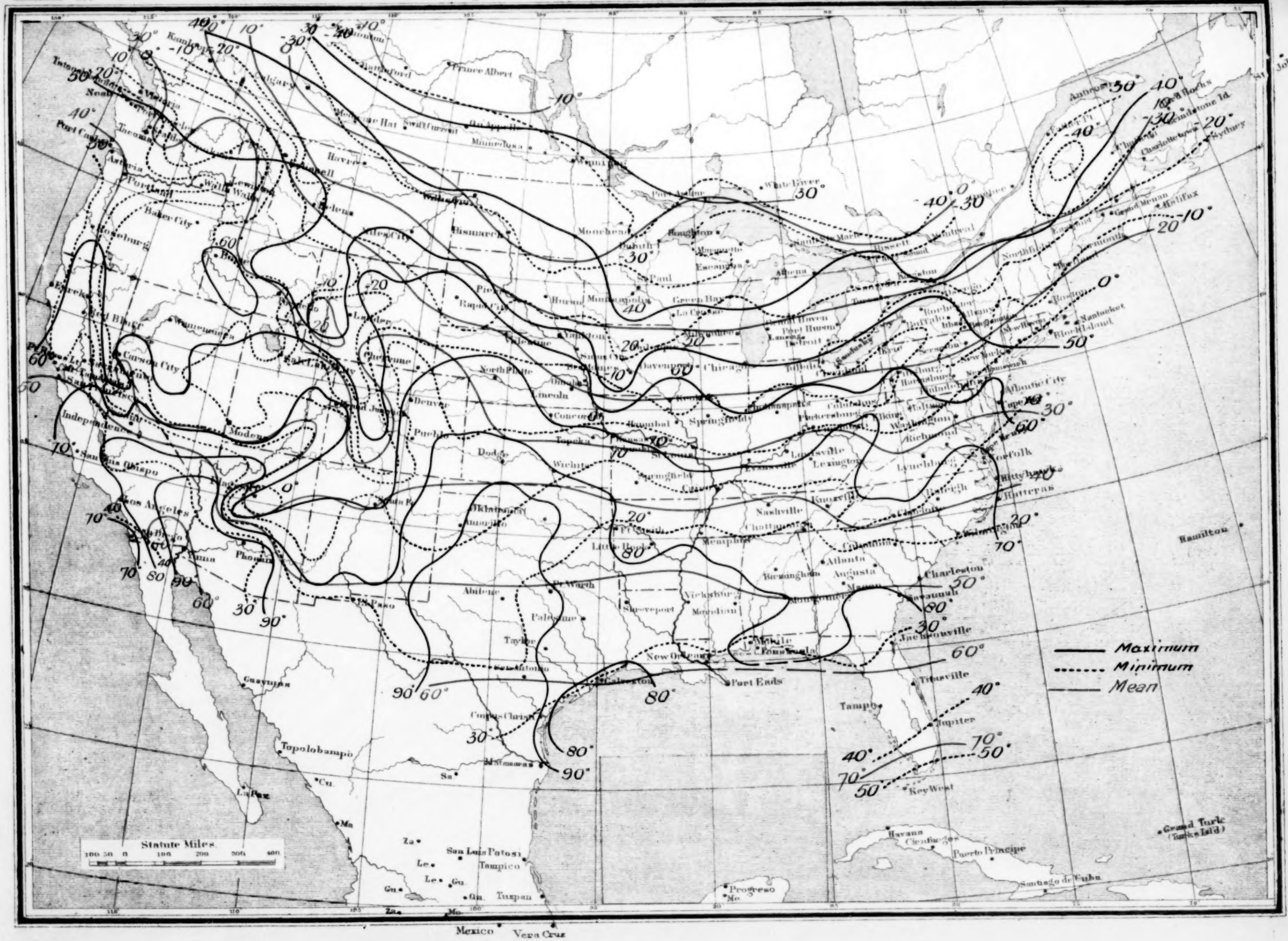
Chart IV. Percentage of Clear Sky. February, 1904.



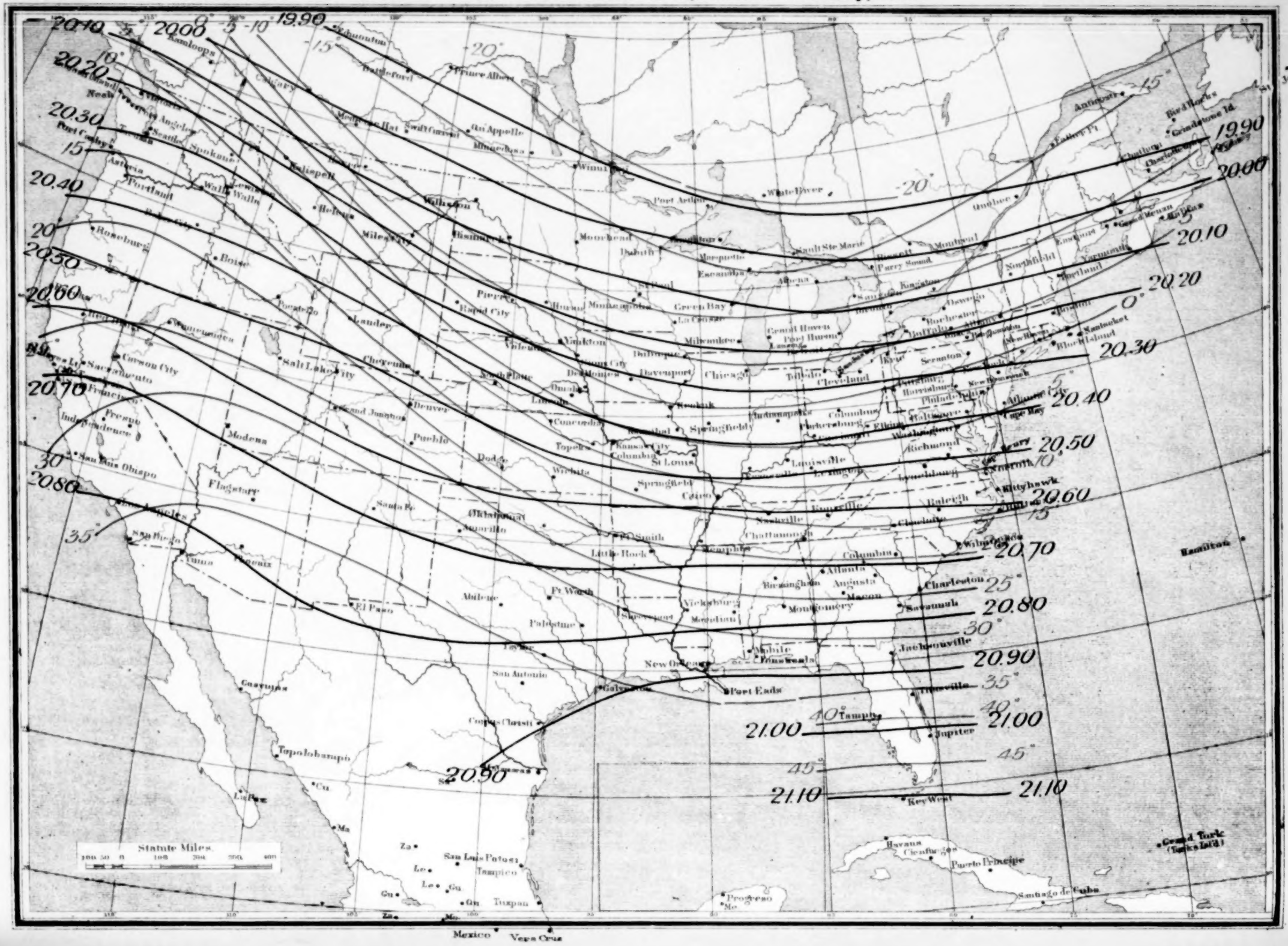
XXXII—17. • Barkerville

Chart V. Surface Temperatures; Maximum, Minimum, and Mean. February, 1904.

Chart V. Surface Temperatures; Maximum, Minimum, and Mean. February, 1904.



XXXII—18. • Barkerville **Chart VI. Isobars and Isotherms at 10,000 feet. February, 1904.**



XXXII--19. • Barkerville **Chart VII. Isobars and Isotherms at 3500 feet. February, 1904.**

• Barkerville

Chart VII. Isobars and Isotherms at 3500 feet. February, 1904.

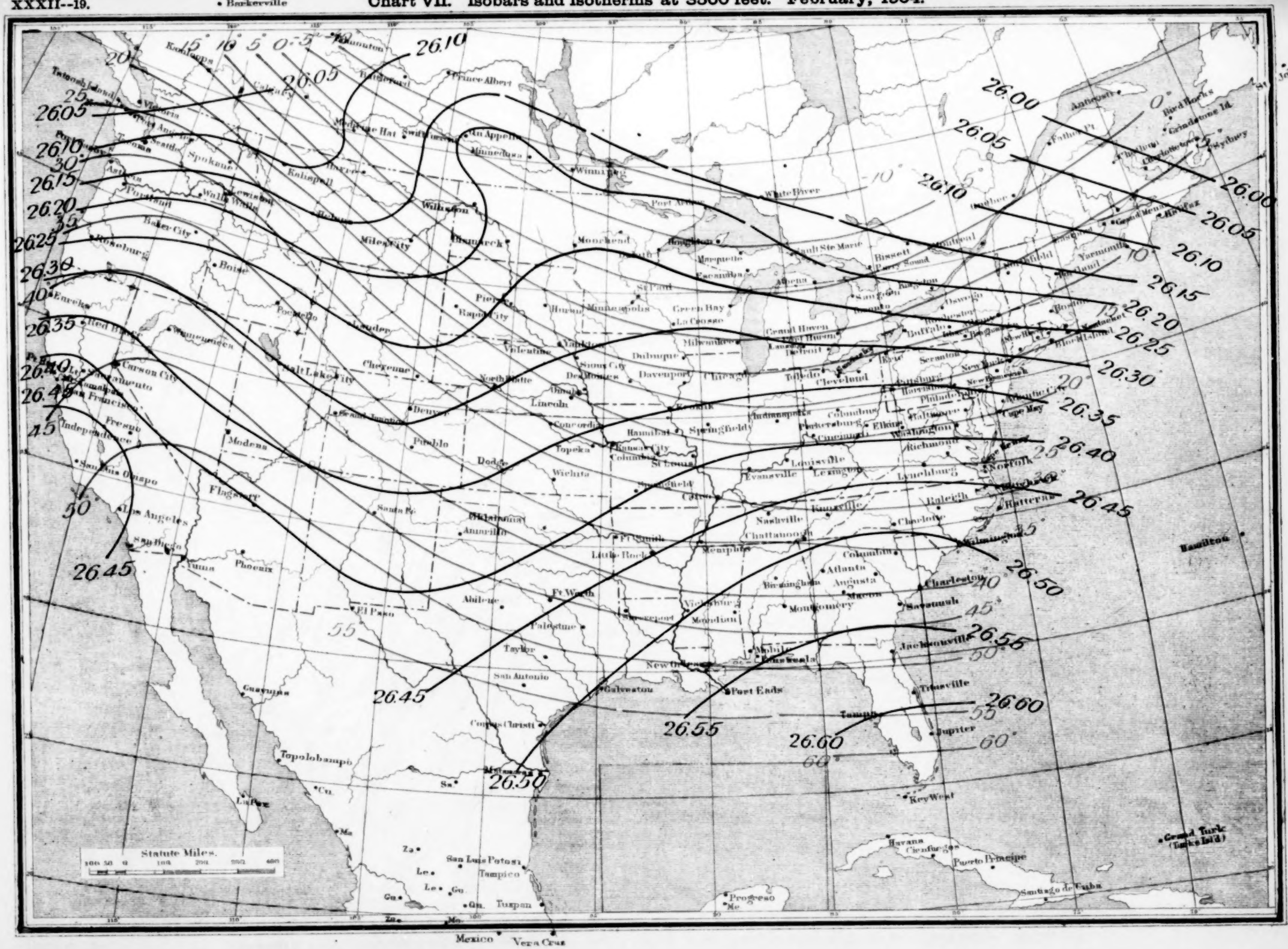


Chart VIII. Isobars and Isotherms at Sea Level; Resultant Surface Winds. February, 1904.

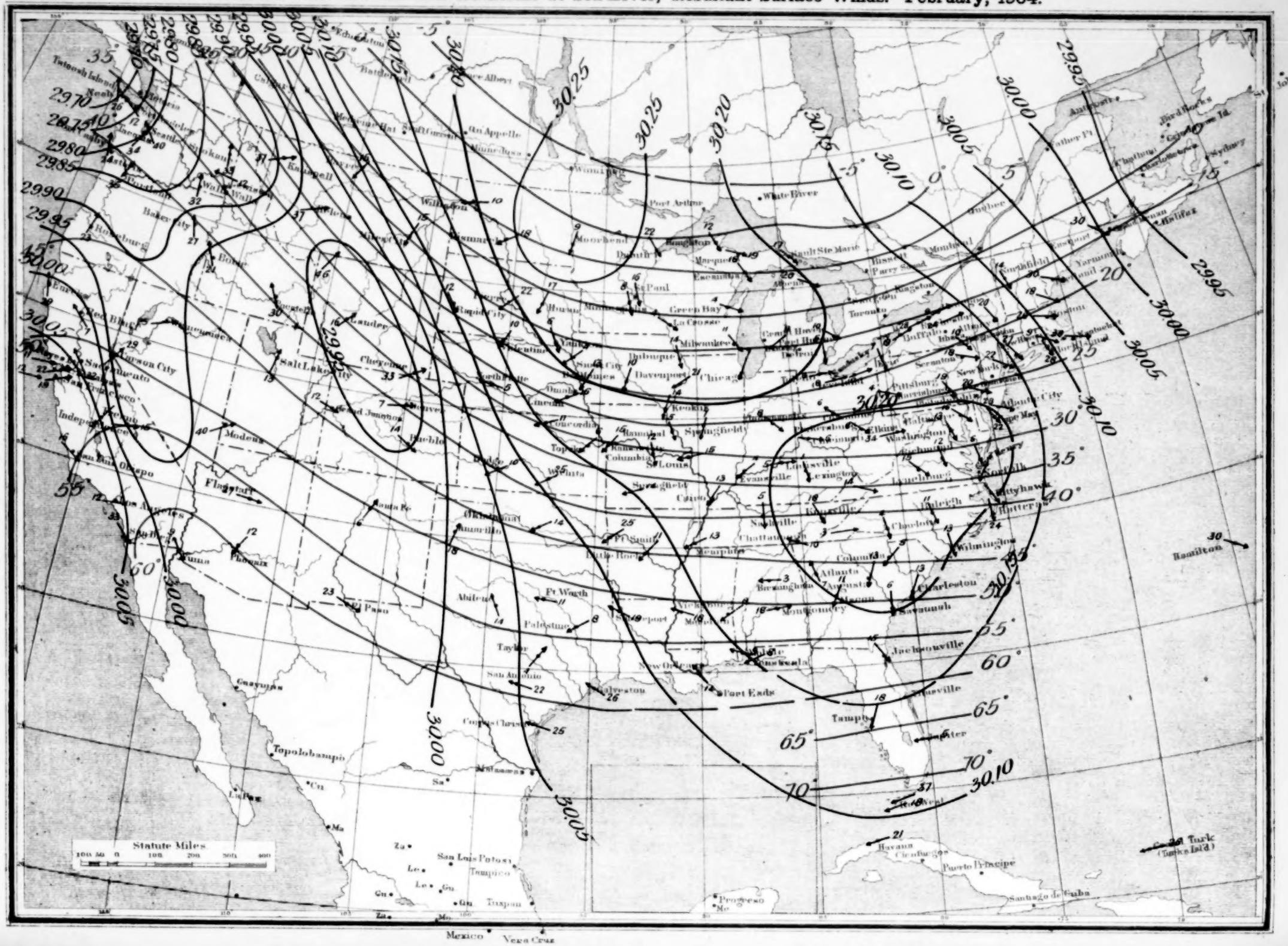


Chart IX. Sea-Level Isobars, Surface Temperatures, and Resultant Winds. February, 1904.

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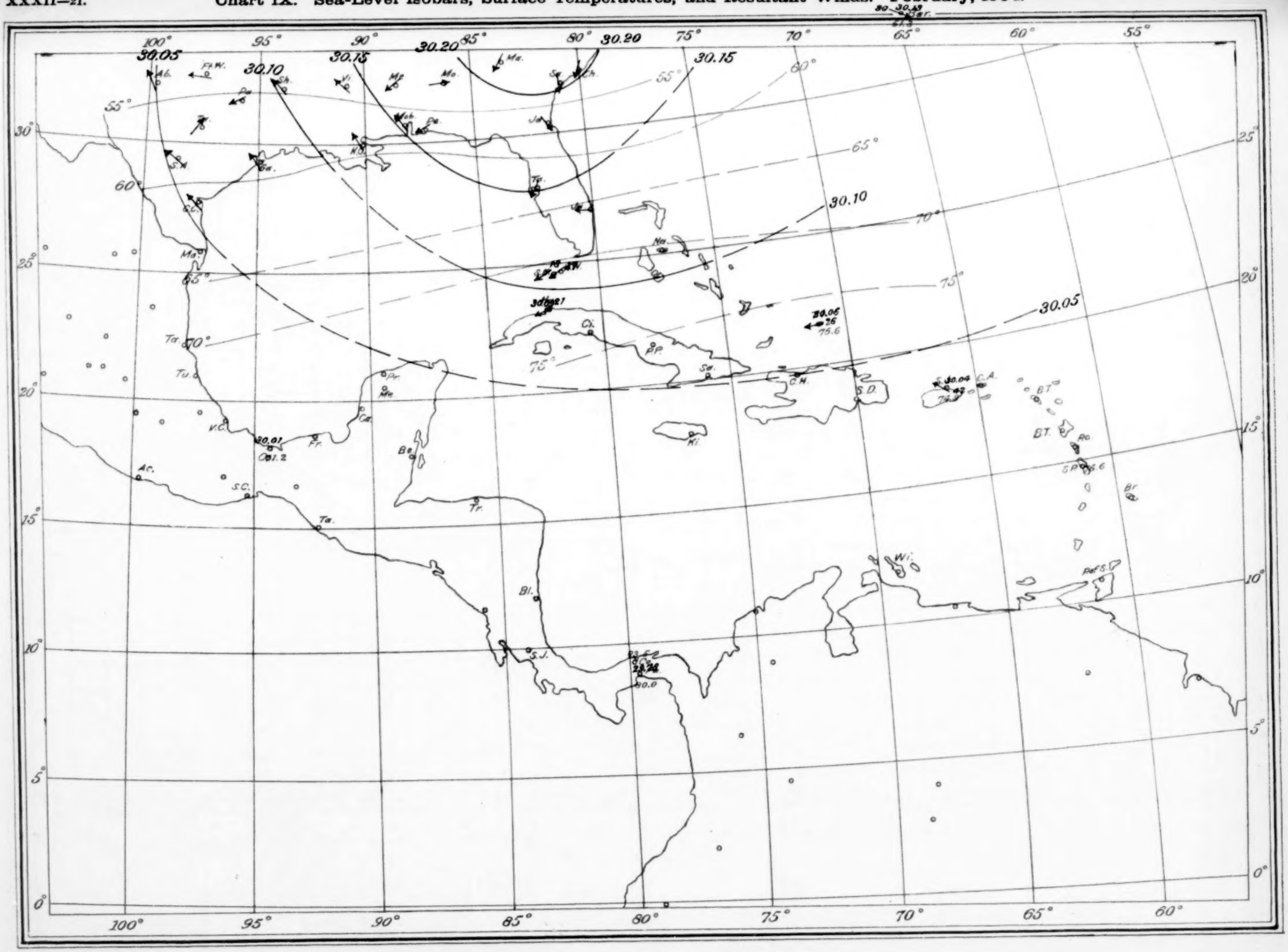
30.05
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30.15
30.20
30.20
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30.05
55°
60°
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75°
25°
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90°
85°
80°
75°
70°
65°
60°
55°
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Chart X. Hydrographs for Seven Principal Rivers of the United States. February, 1904.

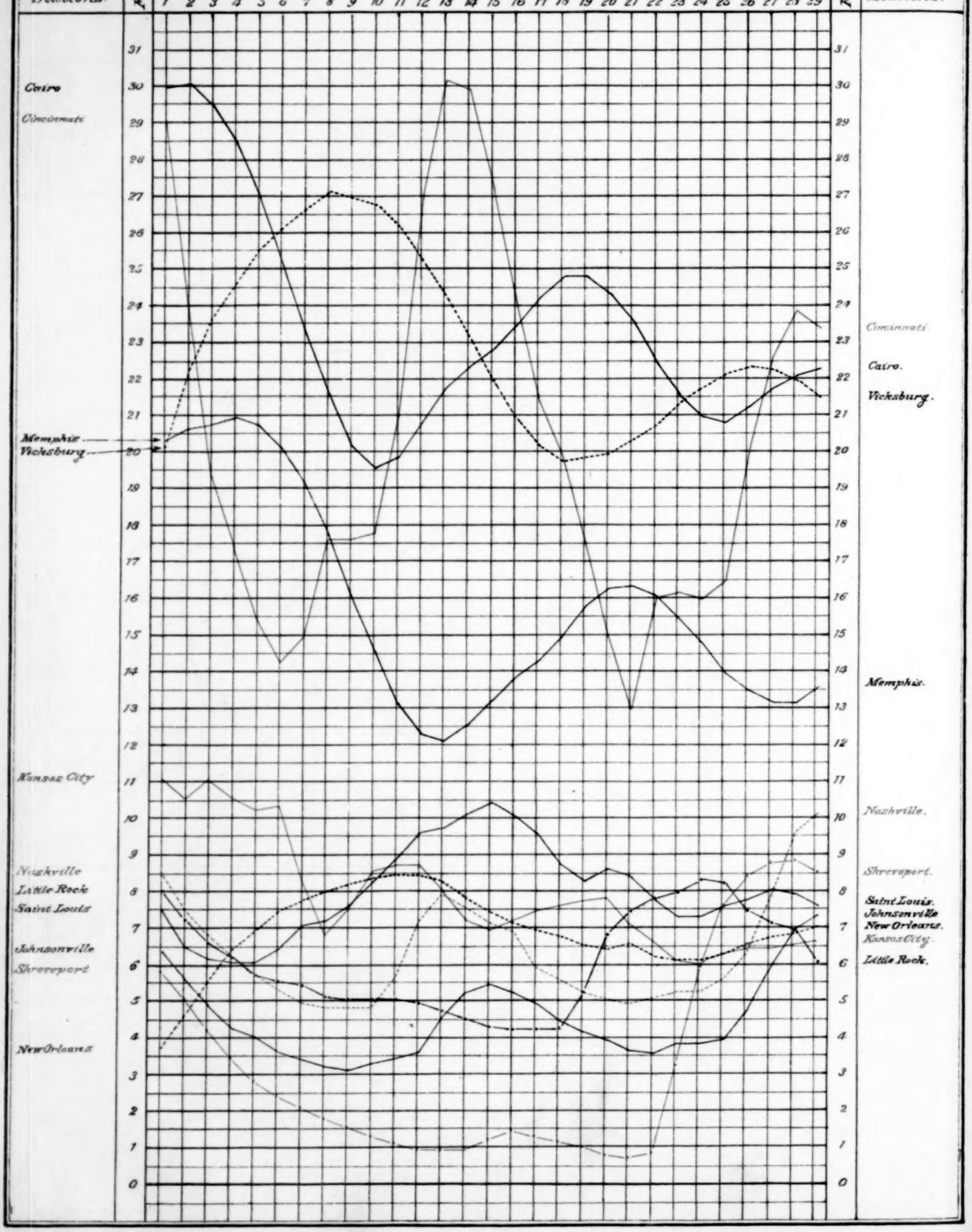
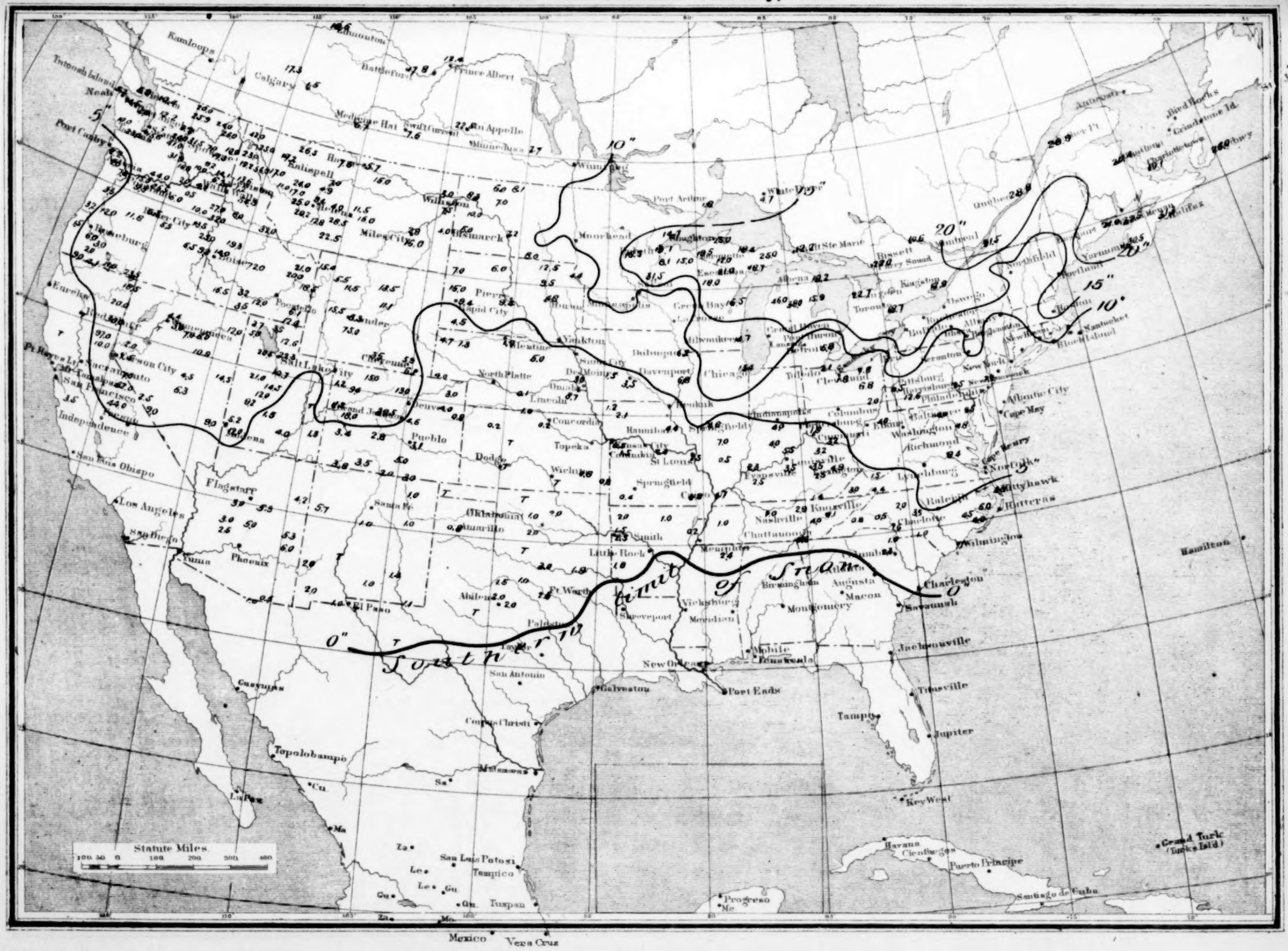


Chart XI. Total Snowfall. February, 1904.

• Parkersville

• Barkerville

Chart XI. Total Snowfall. February, 1904.



• Barkerville

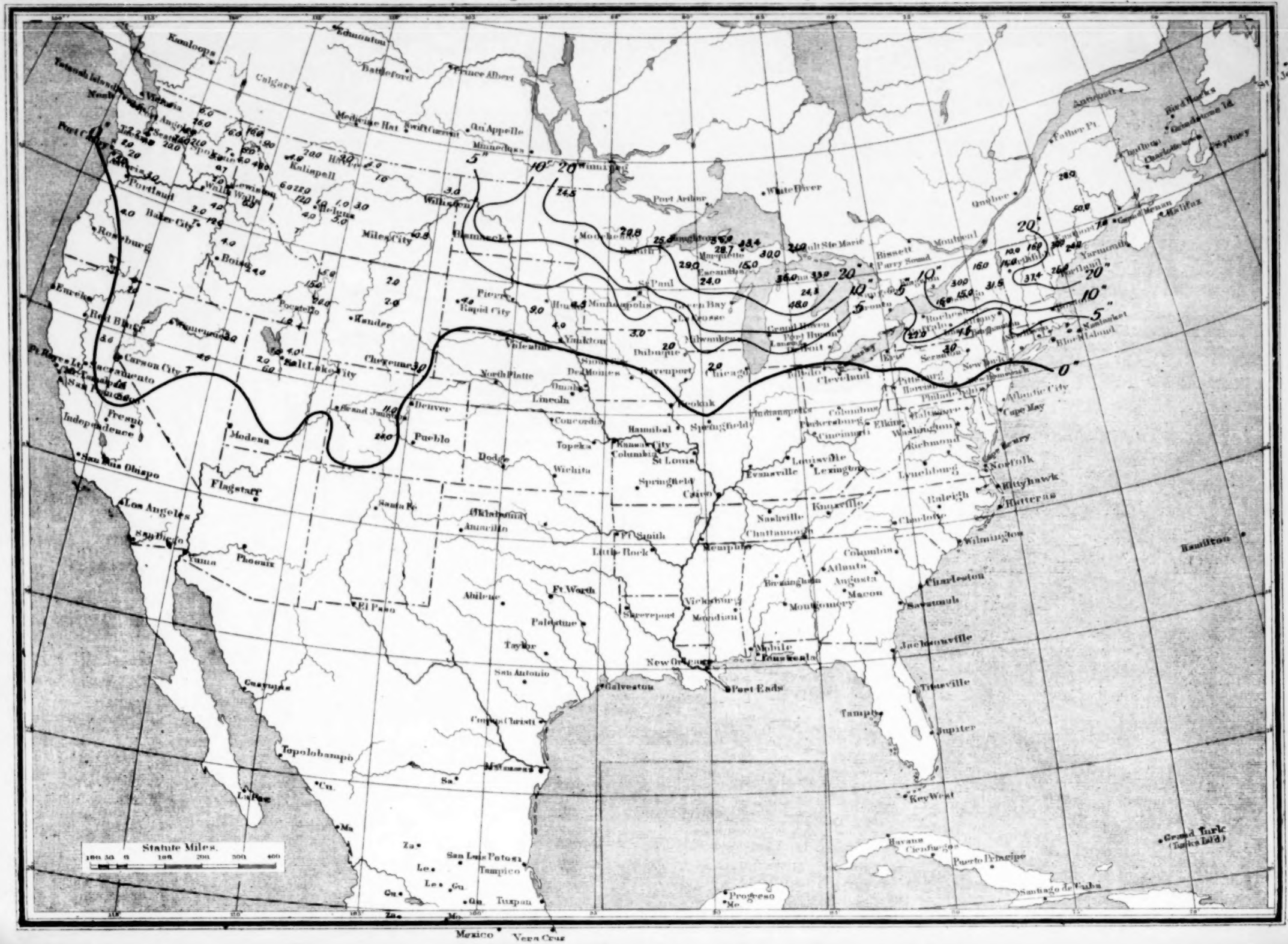



Chart XII. Depth of Snow on Ground. February 29, 1904.